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EXECUTION BY ELECTRICITY.

WITH the New Year there comes into operation in the State of New York a law which must excite the attention and interest of electricians everywhere. It is that which relegates to electricity the duty of putting to death criminals found guilty of murder. This law will probably strike individuals differently, according to constitution and temperament. Some may say—indeed, have already said—that the profession of the electrician is degraded by this base use of his art and his science; others will point to the swift and painless nature of the death by electric shock, and argue from the humanitarian standpoint that it is probably, of all modes of execution, the least barbarous.

We confess that at first we were reluctant to entertain the idea of electrical means being adopted for the purpose. There is something revolting to sensitive dispositions in the idea of putting a fellow being to death by any means, and the association of the medium with which we are brought into daily familiarity, and which we desire to see dedicated to the highest uses in the service of mankind, with deliberate death-dealing naturally excites a feeling of aversion. But this is mere sentimentality—selfish sentimentality; and when we come to reason calmly, we cannot perceive that we have more cause to object or complain than would the hydraulic engineer if death by drowning were proposed, or the cutlers of Sheffield, if the guillotine were to be brought into use in this country. No one looks askance at the rope manufacturer because his productions are employed in dispatching our criminals; no one regards the business of rope making as being degraded by the association. Then why should it be supposed that the profession of the electrical engineer will suffer in common esteem because the powerful agent with which he deals is employed in giving effect to the law? So we will dismiss from consideration this sentimental objection.

But there is another form of sentiment which deserves every consideration: that feeling which desires the least demonstration, the least unseemliness, the least barbarity in the discharge of a very solemn function. Since it is still necessary to carry out the sentence of death, it should be conducted with as little parade and as little that is of a revolting nature as is possible, and this may be effected without causing the dread ceremony to lose anything of its solemnity or impressiveness. No one will seriously contend that execution by hanging has none of those elements of horror which it is desirable for the sake of civilisation and humanity to eradicate. The scenes which are too frequently witnessed upon the scaffold in this country, as well as in others, scenes of sickening horror which we do not care to describe or do more than vaguely refer to, are sufficient to create in most men's minds a wish that more certain and less revolting means could be devised for the execution of criminals. Capital punishment in these days should not aim at inflicting torture; the criminal expiates his crime by forfeiting his life, and the surrender should take place under conditions not calculated to increase suffering, bodily or mental. It may be said that to divest death of all pain would be to take away that element which acts as a deterrent to crime; but we incline to the belief that it is the awfulness of yielding up earthly existence, the mystery attending departure to that bourne whence no traveller returns, which impresses with fear, and not the mere dread of physical suffering. To advocate a speedy and painless death does not necessarily imply sympathy with the individual. It is regard for the rest of mankind that prompts the condemnation of bloodthirstiness in the execution of the murderer, who may deserve, as far as mere desert goes, the worst forms of torture it is possible to conceive. The point is that to put those tortures into practice would argue the existence of feelings of vindictiveness and cold-blooded cruelty, which are not consonant with our boasts of civilisation and advancement. A life for a life is as much as we are entitled to demand, and the dignity and influence of the law are in no wise exalted by clamour for exceptional and additional punishments, even in exceptional cases.

The trend of civilisation, therefore, being towards lessening rather than increasing the horrors of capital punishment, it behoves us to consider whether death by electricity may not be made immediate and sure. We believe it can. Without entering into the question at issue on the other side of the Atlantic between the advocates of the continuous system and the advocates of the alternating system, we assert our belief that in proper hands there need be no hitch and no fear of failure with the electric current. But it will scarcely do to place the sole control of the preparations, as we see has been suggested, in the hands of a professional executioner. A competent electrician should superintend every detail of the arrangements, so as to ensure absolute certainty of action. The simple process of completing the circuit, so far as the electrical apparatus are concerned, should alone be entrusted to the executioner, excepting that it should, of course, be his duty to bind and pinion the culprit and to attach the apparatus by which contact with the skin would be made; but these apparatus should be of so simple a character that they might be almost instantaneously applied, without the possibility of a mistake being made. No extraordinary amount of ingenuity is called for to construct such contrivances, and by their aid the interval during which the criminal would be aware that the end had come, would be reduced to a minimum. The electrician need take no part in the actual doing to death of the victim; his arrangements adequately made, he might depart from the scene of execution, unless he desired to witness the effects of the electrical current which would be employed upon the body. Such an execution might be conducted with perfect certainty, with painlessness, and with but few moments of suspense for the victim. Still there would be the awfulness to the criminal mind of a mysterious death—death by a lightning stroke. We see no objection to this mode of execution, except so far as objection can be made to execution altogether, and we see no insuperable difficulty in the way of its adoption. It is needless to specify the various methods adopted elsewhere for carrying out the death sentence, or to give in detail the objectionable elements in each case. They will present themselves to the mind of the reader, and, if he be fair-minded, we think he will ultimately incline to our way of thinking, namely, that, so long as capital punishment obtains, death by electricity is the least revolting form which it can assume. No bloodshed; no horrible struggles or contortions; no bungling half-hanging through the swelling of timbers; but death, swift, sudden and painless: one moment the man is, the next he is not.

LIEUTENANT-COLONEL WILLIAM HAYWOOD, engineer and surveyor to the Commission of Sewers, and Mr. W. H. Preece, F.R.S., have made a report to the Streets Committee of the Honourable the Commissioners of Sewers, on the conditions of contract for the supply of electricity to the City of London. At the moment we do not purpose dealing *in extenso* with the report of the first named gentlemen, but that of Mr. Preece we publish on another page. It will doubtless be a source of surprise to our readers to learn that Mr. Preece only knows of three companies capable of carrying out electric lighting in the City, and this surprise will be all the more profound when it is seen that one of these has not yet, so far as we are aware, accomplished anything to warrant the recommendation. The *bonâ fides* of the Anglo-American Brush Corporation and of the London Electric Supply Corporation are beyond doubt, but why, we would ask, are Messrs. Siemens Brothers left out of the question; why Messrs. Crompton & Co., Limited, who have probably had more experience than anybody else in this country with underground mains? There are others we might mention who could probably do the work in a far more satisfactory manner than at least one of the three companies who, in Mr. Preece's opinion, are the only people in a position to supply current to the City, and whose financial condition would doubtless satisfy the demands of the Commissioners of Sewers.

MR. PREECE suggests that it is undesirable to throw the work of lighting the City open to public tender, on the ground that to do so would be to court wild and impracticable proposals from schemers and speculators. We think that the Chief Electrician to the Post Office does himself an injustice here, for although of course he does not pose as an electric light engineer, he could surely, with the assistance of his colleague, easily sift the grain from the chaff. But the question of what is best in the way of competition may safely be left to the members of the important body which controls the street lighting of the City.

LIEUT.-COL. HAYWOOD reports that having considered the Electric Lighting Acts, and what the Commission of Sewers has hitherto done in electric lighting, he has arrived at the conclusion that the Commission, on the whole, cannot do better than to adopt generally, as a basis for a specification for supplying the City with electricity, the articles of agreement, with some modifications, which were proposed last year to be entered into with the Anglo-American Brush Corporation.

BEFORE such a specification can be drawn, however, the City engineer thinks that the Commission must determine whether gas shall be abandoned altogether for street lighting; and in connection with this matter he considers that moderate lights at short distances apart, such as the gas lamps which now exist, give a more uniform distribution of light over the entire street surface than would more powerful centres of illumination at long distances apart. This is, of course, a fact which has long been known, and which nobody will deny, and we agree with Lieut.-Col. Haywood when he says:—"It does not appear to me that the street lighting need necessarily form part of any contracts with a company for supplying electricity generally to the City."

WILL it abandon gas? This is a question which requires the gravest consideration from the Commission of Sewers. We cannot, at the moment, recall an instance of the City streets being placed in darkness during the past 20 years through failure of the gas supply. Private consumers are naturally at liberty to adopt what kind of lighting they choose, but it is a matter of the highest importance that the streets shall be lighted by that medium which gives the least chance of extinction from any cause whatsoever.

MR. PREECE says he has shown that the most effective way to light streets is by means of incandescent lamps. We suspect that this gentleman is the only individual who holds such an opinion. The results of the Edison experiments on the Holborn Viaduct, the lamentable failures in the Leamington thoroughfares and the mishaps at Barnet which are fresh in the minds of everybody, all go to show that Mr. Preece is far from correct. Let us have arc lights by all means in the main roads where their advantages may be clearly shown, but Heaven forbid that the City authorities should countenance a combination of arc and glow lamps, the latter merely to replace without any corresponding advantage the ordinary gas lights which meet the requirements of any side streets.

IT is pretty evident that whoever gets the contract for lighting portions of the City by electricity will have to be prepared to lay down underground conductors, for the City Engineer does not think it advisable to encourage any further extension of overhead wires, and Mr. Preece states definitely that the leads must be subterranean. One company at least, of the three recommended by the last-named gentleman, whose high tension system of mains is at present an overhead one, will probably gain a new experience in the use of transformers if it should be fortunate enough to secure a portion of the mapped out district.

IN the opening number of *The Telephone*, the new electrical journal of which we have already spoken, Mr. A. R. Bennett suggests, in a pleasantly written article, the word *telephrase* as the specific name for a telephonic message. *Telelogue* was proposed some years ago, but somehow or another it did not commend itself, yet, from Mr. Bennett's own showing, we prefer it to his suggestion. Mr. J. D. Miller publishes the first article of a series on "Practical Information for Telephone Instrument Inspectors," and, judging from the initial instalment, these papers promise well. Mr. C. L. Madsen, of the Copenhagen Telephone Company, gives a really valuable series of experiments which he has made on the basis of Mr. Preece's telephone equation, which is only another form of Sir William Thomson's law for determining the number of currents which can be transmitted through a submarine cable in a second. Mr. Madsen has found that the limit of speaking, or efficiency of transmission, on telephone lines varying in length from 37 to 180 kilometres in no way depends upon distances, but on the composition of the line and the number of exchanges placed thereon. We may say more upon this subject in our next issue. The multiple switchboard and its details form the theme for an interesting discourse by Mr. J. B. Poole, engineer to the Lancashire and Cheshire Telephone Company, and a writer whose name does not transpire, describes Sir William Thomson's standard electrical measuring instruments with all the latest improvements.

AT a meeting of the Société Royale des Sciences Medicales et Naturelles of Brussels, held on the 5th of November, it was announced by the president that prizes given by an anonymous donor would be awarded for "the determination of the value in electrical units of the normal currents which exist in living tissues, such as the nerves, the muscles, the glands;" the value of the prize is 500 francs, the work to be completed at the end of the coming year. Similar prizes will be awarded for "Researches on the conductibility of organic liquids (lymph, plasm, serum) for currents of low potential, and, if possible, researches on the conductibility of the tissues;" and for "A *resumé* of the work done up to the present with reference to electric endosmose, and researches on the possible applications of the theory of electric endosmose, the phenomena of absorption, and of secretion in living organisms."

M. FERNAND GODFROY, in a communication to the Academie de Sciences, which we published on the 30th November last, describes the results of some experiments which he has made relative to the increasing of the working capacity of telegraph lines. The method consists of placing either at the centre or at the ends of the line a leak resistance, having a certain coefficient of self-induction. The author argues that the self-induction prevents the leak from drawing off the portion of the current first transmitted from a signal, and afterwards, by the extra current set up, neutralises the static discharge from the line. He has experimented on an underground line having a length of 500 kilometres, a resistance of 5,000 ohms, and a static capacity of 100 microfarads. The leak consisted of a resistance of 780 ohms, having a coefficient of self-induction equal to 12 units; the battery used consisted of 50 Callaud elements. A speed of 20 words per minute was obtained by direct working on an ordinary Morse recorder; it is not stated, however, what speed was obtained *without* the leak, so that the experiment, without this information, does not amount to much. We fancy the communication has not the merit of novelty, at least, to our Postal Telegraph engineers; nor is method the only, or indeed the best, way of obtaining high speed working. M. Godfroy has probably never heard of a shunted condenser.

WE need scarcely remind our readers that we have frequently called attention to the exaggerated notions contracted in the minds of many estimable persons regarding the dangers to be apprehended from the overhead wires in London, and we have shown that statistics have proved this danger to life and limb to be more imaginary than real. We are glad to see that Lord Crawford called attention to the matter at the recent meeting of the London Electric Supply Corporation, where he stated that his Company had every confidence that where the mains are put up in a proper manner, and by using the greatest care and the best material, which is the case with the Company's mains, they could be made safe, and the rate of depreciation would be very small indeed. The dangers which are spoken of, said the noble lord, are very much exaggerated, and in many cases they do not exist at all. After they had been at work for three years and six months, and after the present Corporation had been at work for nearly a year, the Board of Trade sent a letter saying that they heard the Company was using overhead wires, and they wished to know the factors of safety which were employed in putting those wires up, and also what precautions had been taken with regard to preventing shocks to persons. The Board of Trade sent officials to make an inspection; they went away satisfied, saying that the experiments were most conclusive. Naturally electric lighting corporations have every desire to place their conductors overhead, and the experiences of the London Electric Supply Corporation will, we hope, be specially brought before the notice of the authorities who control the regulations for the erection of wires for such purposes.

ELECTRICAL NOTES FROM SWEDEN.

THE Swedish Government is now laying the telephone line between Stockholm and Gothenburg to which we recently referred, and which the General Telephone Company of Stockholm had offered to lay. It has been completed as far as the city of Vesteras, a distance of 113 kilometres, and is now being laid towards Orebro, in Central Sweden. The wires, of copper, are double, one being 2·5, and the other 3 mm. in thickness, the thickest being intended for communications direct from the two end stations, and the thinner for joining with local telephone nets in the provinces. The wires are laid on the telegraph poles, and have been made at the Skultuna copper works. It is expected that the whole line, Stockholm—Gothenburg, will be ready at the end of this month, and then the whole of Sweden will practically have become connected by telephone.

The electric light is also making tremendous progress in Sweden, as the following notes will show.

The municipality of the city of Stockholm has decided upon establishing a central electrical station in the Swedish capital, which is to be managed by the city gas works. It is hoped that by the more extended use of the electric light, it will not be necessary to erect new gas works just at present, which were urgently needed. The system adopted in the so-called "three cable" system, whereby wires are laid from a central station underground through the adjacent streets. Offers for laying the installation have been received from five firms in England, Germany, and Austria, but the work will be entrusted to Messrs. Siemens and Halske, of Berlin, on account of the experience already gained of the electrical work done by this firm in Sweden. There are now 8,000 glow lamps lighted in Stockholm, and the new central station is to be capable of lighting 8,000 more, but provisionally only half that number will be fixed. The price is to be 4·5 öre (½d.) per lamp per hour, the maximum hours being 700 per annum, whilst during the light summer nights, when the light is not much required, the machines will store the electricity for future use in accumulators. The cost of the whole installation is estimated at £34,500, and the receipts per annum at £7,000. Allowing for expenses, and 4 per cent. interest on capital, this is estimated to yield a profit of 4·3 per cent. The gas works having invited subscribers for the light in the two parishes around the site of the central stations, 164 such have already requisitioned it for a total of 4,052 lamps, whilst more are daily subscribing. Of this number, 1,460 are for shops, and 500 for private dwellings.

A private central electrical supply station has also just been opened in another part of Stockholm, the plant having been laid by the Eriksson Engineering Works of Stockholm. There are four compound engines of 100 horse-power each and four dynamos of Messrs. Siemens and Halske's construction, capable of feeding 1,000 glow lamps each. This concern has been transferred to a new electric company, entitled the Stockholm Electric Light Supply Company, and it has already over 2,000 subscribers, among whom are the Crown Prince of Sweden for his wing in the Royal Palace, several leading banks, business houses, restaurants, &c. The light to the Royal Palace is supplied by four cables, and shortly the whole of it is to be lighted by electricity. Hitherto only King Oscar's dining and billiard rooms have been lighted by electricity supplied by a dynamo on the premises. Another station has been built by the Mortgage and Guarantee Company, of Stockholm, supplying 16 business houses. The price is £1 3s. 8d. for a 10 candle-power lamp and £1 12s. 6d. for a 16 candle-power lamp a year. The demand for electric light is so great that this company cannot at present supply all those who desire the same.

Turning to public buildings in Stockholm we find that most of them are now lighted by electricity. Among the latest to adopt it are the Houses of Parliament, which are experimentally lighted by the Eriksson Works, referred to above, with 10 arc and 103 glow lamps in both chambers most successfully. The cost is 6s. 6d. per hour for the 10-arc lamps, and a similar one for all the glow lamps. Next we have the General Post Office and the Royal Opera House. In the former the installation comprises two engines of 30 horse-power and two dynamos feeding 350 glow lamps, whilst in the latter 300 lamps are fed by an installation at the City Gas Works. Most of the plant for these installations has been supplied by Messrs. Luth and Rosén, of Stockholm.

From the report just issued of the Electrical Company of Stockholm it appears that the operations of this company are increasing year by year. Thus, during the first four years of the existence of the company, only 67 dynamos of 633 electrical horse-power were sold, against a sale last year of 20 dynamos of 287 horse-power, 2,650 glow lamps being installed, with only 5,300 in the four preceding years.

By way of comparison, it may be of interest to state that the consumption of gas last year in Stockholm amounted to 9,835,000 cubic metres, being 5 per cent. more than in 1886, of which 2,122,000 were used for public and the remainder for private consumption. The cost of the former was £20,000. The average price of gas for private consumption was 2¼d. per cubic metre. The net profits of the gas works for the year was £22,000. *Apropos* of gas *versus* electricity, it may be added that in the city of Orebro the price has been lowered from 7s. to 5s. 6d. per 1,000 cubic feet this autumn, in consequence of the severe competition with the electric light.

Turning to the provinces in Sweden, we find an equally remarkable progress, one town vieing with another in adopting the electric light. In Hernösand, for instance, a central station is to be established for lighting the streets at a cost of £3,000, the profit being estimated at £800 a year, whilst similar stations are also to be established in Motala, Boras, Falun, and Sundswall. In the two former towns the municipalities will supply the light. At Falun there are to be 48 arc and 1,500 glow lamps, at a cost of £1,500; and in Sundswall 1,000 glow lamps, at a cost of £3,000. In Vesteras the celebrated old cathedral is also to be lighted by electricity. A company named the "Electron" has been formed in Gothenburg, principally by English merchants, for lighting that city by electricity, with a capital of £10,000, more than half of which has been subscribed in England.

Even in the country in Sweden the electric light is being introduced, several farmers obtaining it through waterfalls near their dwellings. At one farm, for instance, the owner has himself effected the installation, the dynamo being worked by a two-horse power turbine in a river close by, the whole plant costing only £25.

A factory has been established in Stockholm for the manufacture of glow lamps, the first of its kind in Sweden, capable of turning out 2,000 lamps a week.

Great satisfaction is expressed among Swedish electrical engineers, of whom there is now a large number in America, at the introduction of the electric light produced by the Wenström method, that of a Swedish electrical engineer, in the city of Baltimore, the principal hotel in that town having adopted this light after a keen competition with other systems. The work of installation, which was carried out by a young Swedish engineer, has proved satisfactory in every respect. Moreover, another electrical engineer, M. E. J. Beskou, has invented a transportable electric light apparatus, which was tried the other day in the presence of a number of naval and military officers with the greatest success. The apparatus differs from others chiefly by the boiler, engine and dynamo all being mounted on the same carriage, which still may be drawn by two horses only. The engine, of 5 horse-power, acts directly on the dynamo without driving bands or other agency, whereby the light becomes much steadier. The revolutions are about 1,000 per minute, and the electrical force from 40 to 50 volts and 65 ampères, equalling about 12,000 normal candle-power, a light proving sufficient even to distinguish different colours at a distance of 3,600 metres. Trials were also made with the apparatus at sea as a search light from a boat, which proved equally satisfactory. It is also specially advantageous by working perfectly noiselessly. This apparatus is particularly suitable in war for field work or in coast defences.

Of more general news from Sweden is the introduction of the electric light in the cars on the express line Gothenburg-Christiania—the first thus lighted in Scandinavia. A station is to be established in the former city and the trains lighted by accumulators. The first railway in Sweden has also recently been fitted with electric bells, but the news from the city of Sundsvall is of still more interest, as the Thomson-Houston Company, the well-known Boston electrical engineers, are now about to lay the first electrical tramway there, as well as lighting the town by electricity, the motive power being obtained from a powerful waterfall in the vicinity. The firm shows by calculations that the undertaking will pay, and even offer to let the plant work on trial for some while before being taken over by the city. This is another instance with what cheapness and ease electricity may be adopted for various purposes in Scandinavia through the water motive power being at hand everywhere.

A Swedish electrical engineer, M. John Landin, has invented a process for tanning by electricity, which has proved so satisfactory that an influential company, called the "Tannin," has been formed for working the same. By this process leather may be tanned in from 50 to 90 hours, as against several months by the old common method, and still the quality is equally good. Finally, a M. Nordell, of Nässjo, a watchmaker, has constructed and patented a clock, in which the pendulum is worked by electricity, it being also possible to connect the same with any number of other clocks. It will, therefore, be gathered from the above that the Swedes are far from lagging behind among the nations of the world in adopting the new motive power in every branch of trade and industry.

DYNAMO REGULATION BY MEANS OF A THIRD BRUSH.*

By EDWARD CALDWELL, A.B., M.E.

THE following study of methods of third brush regulation of series dynamos for *constant current* was taken up at the suggestion of Prof. Nichols. During the progress of the experimental work it was discovered that a similar method of regulation might be applied to a series-wound dynamo for the production of a *constant electromotive force.* The investigation was made to include, therefore, the applicability of this method of regulation to a series-wound dynamo, both for a constant current and a constant electromotive force.

The dynamo used in this work was a small series-wound machine, with two upright field magnets of the Edison type and a Gramme armature. The cores and yoke were of the best Norway iron. The principal dimensions and constants of the machine were as follows:—

Diameter of armature, outside	4¾ inches
Length „ „ „	2¼ „
Number „ „ coils	30
Resistance „ through brushes ...	·72 ohm
Diameter of field magnet cores	2⅜ inches
Length of field magnet cores	7⅜ „
Size of yoke	2″ × 2⅜″ × 10¼″
Turns of wire on each field coil	785
Resistance of each field coil	·8 ohm

A third brush, held by an independent brush holder, was placed upon the commutator between the regular brushes. This could be set at any desired angle in advance of the positive brush, a pointer indicating the angle upon the graduated circumference of a wooden ring placed concentrically with the shaft. Another pointer indicated in a similar manner the angular lead of the regular brushes. Each of these pointers was set at zero of the graduated scale when the brush which carried it rested at the upper end of the vertical diameter of the commutator—a point midway between the edges of the pole-pieces.

The field was explored for distribution of potential around the commutator by a modification of a method described by Prof. Brackett in a paper read before the American Institute of Electrical Engineers in 1884, and published in Vol. I. of the *Transactions.*

The current was measured by a tangent galvanometer, the coil being formed of a single ring of copper, 50 centimetres in diameter, and of rectangular cross-section. Its constant was determined by comparison with the large standard tangent galvanometer, in the Magnetic Observatory of Cornell University. The deflections could easily be read to tenths of a degree.

The E.M.F. was measured by an Ayrton and Perry voltmeter which had previously been calibrated. The voltmeter was shunted across the regular brushes of the machine.

The resistances used in the external circuits were made of German silver wire coiled in the form of a spring and stretched upon upright wooden frames. By means of a copper hook contact could be made at any desired point. These coils were standardised by comparison with the coils of an Elliott Bros. resistance box of the dial pattern.

The arrangement of the apparatus during the first portion of this investigation differed from that of the Waterhouse Electric Company in their system of third brush regulation for constant current, only in that the point of contact of the main line with the resistance coils of the regulator was varied by hand instead of by automatic means.

The connections used are shown in diagram I. The switchboard contained eight small mercury cups—two each for the terminals of the galvanometer, the third brush line, and the main line, and was so arranged that the galvanometer could be placed in any one of the three circuits.

The machine was first run at 2,500 revolutions as an ordinary series machine with two brushes, these being adjusted to the non-sparking position with a lead of about 12°. Table 1 gives the data obtained from which the characteristic curve in plate A is plotted.

TABLE 1.

Volts.	Ampères.
11	·21
39	·87
49	1·54
54	2·35
55·1	3·09
54·6	4·11
51··	6·90

It will be noticed here that a very small amount of current is sufficient to saturate the field magnets, because of the very large number of turns of wire on the field coils.

With the third brush upon the commutator a study was made of the effect of increasing the angular distance between the third and positive brushes. The tabulated results are given in tables 2 to 6. The third brush remained fixed through each set of observations, and the main brushes, at a lead of 12°, through all the five sets. The resistance between the third and positive brushes was 21 ohms.

The curves of relation of E.M.F. and current, of which curve *b*, plate A, is an example, need not be plotted, as an inspection of the tables will show, that within the limits of regulation, the curves are superposed vertical lines, if the volts be taken as ordinates and the ampères as abscissæ. Curves 1 to 4, plate A, are plotted from tables 2 to 6.

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* Revised abstract of graduating thesis, Sibley College, Cornell University, June, 1888.

These curves are straight lines, and they show that the condition necessary to constancy of current in a series dynamo, namely, direct proportionality of external resistance and current in the field coils, has been secured. They also show that the greater the lead given to the third brush, the greater the field current necessary to keep the external current constant, the external resistance being the same. This will also be seen by a comparison of columns 3 and 7 in tables 7 to 10. These tables are compiled from tables 2 to 6.

	Volts.	Ampères main line.	Ampéres field line.	Ampères third br. line.	Ohms in main line.	Extra res. in field.	Angular advance of third brush.
Table 2.	11·	1·70	·39	1·31	5	16·5	24°
	29·	„	·77	·93	10	12·9	
	39·	„	·99	·69	15	9·4	
	46·1	„	1·47	·23	20	5·1	
	50·	„	1·68	·02	25	1·4	
Table 3.	7·	1·70	·29	1·41	5	19·3	48°
	29·	„	·78	·92	10	15·1	
	41·2	„	1·12	·58	15	12·0	
	49.	„	1·52	·18	20	7·9	
	52·3	„	1.84	–·14	25	3·0	
	53·5	„	1·96	–·26	30	0·	
Table 4.	12·	1·70	·35	1·35	5	20·	72°
	35·	„	1·01	·69	10	16·8	
	47·7	„	1·48	·22	15	11·4	
	51·6	„	2·05	–·35	20	6·5	
	53·4	„	2·35	–·65	25	2·3	
Table 5.	43·	3·23(?)	1·09	2·16	5	21·	96°
	47·	1·84(?)	1·24	·60	10	21·	
	53·5	1·70	2·13	–·43	15	10·	
	55·1	„	2·61	–·91	20	5·	
	55·0	„	2·76	–1·06	25	2·5	
Table 6.	51·	1·70	1·88	–·18	5	21·	120°
	54·3	„	2·61	–·91	10	12·	
	55·1	„	2·68	–·98	15	9·9	
	55·3	„	3·08	–1·38	20	4·7	
	55·3	„	3·37	–1·67	25	1·7	
Table 7.	29·	1·70	·77	·93	10	12·9	24°
	29·	„	·78	·92		15·1	48°
	35·	„	1·01	·69		16·8	72°
	47·	...	...	·60		21·0	96°
	54·3	1·70	2·61	–·91		12·0	120°
Table 8.	39·	1·70	·99	·69	15	9·4	24°
	41·2	„	1·12	·58		12·0	48°
	47·7	„	1·48	·22		11·4	72°
	53·5	„	2·13	–·43		10·	96°
	55·1	„	2·68	–·98		9·9	120°
Table 9.	46·1	1·70	1·47	·23	20	5·1	24°
	49·0	„	1·52	·18		7·9	48°
	51·6	„	2·05	–·35		6·5	72°
	55·1	„	2·62	–·91		5·0	96°
	55·3	„	3·08	–1·38		4·7	120°
Table 10.	50·	1·70	1·68	·02	25	1·4	24°
	52·3	„	1·84	–·14		3·0	48°
	53·4	„	2·35	–·65		2·3	72°
	55·0	„	2·76	–1·06		2·5	96°
	55·3	„	3·37	–1·67		1·7	120°
Table 11.	1·	1·00	·10	·90	5	18·7	36°
	10·	„	·32	·68	10	16·6	
	28·	„	·40	·60	15	13·0	
	29·	„	·62	·38	20	11·8	
	38·	„	1·00	·0	30	4·0	
	40·5	·92	1·07	–·15	40	0·	
Table 12.	5·	1·30	·31	1·19	5	17·4	36°
	25·4	„	·49	1·01	10	14·9	
	34·0	„	·83	·67	15	11·5	
	41·2	„	1·22	·28	20	6·0	
	45·	1·38	1·56	–·18	30	0·	
Table 13.	14·0	2·00	·48	1·52	5	16·5	36°
	34·5	„	·81	1·17	10	13·0	
	44·	„	1·48	·52	15	6·8	
	47·5	„	2·00	·0	20	0·4	
	45·0	1·38	1·56	–·18	30	0·	
Table 14.	25·	2·50	·61	1·89	5	15·8	36°
	43·6	„	1·50	1·00	10	9·0	
	47·7	„	2·38	·12	15	1·7	
	48·0	2·14	2·22	–·08	20	0·	

But the most interesting as well as the most important phenomenon shown by all of these tables alike, is the change of sign of the current in the third brush line. Under some conditions the third brush acts as a positive brush, and under others as a negative.

DIAGRAM I.

G, galvanometer; R. K, reversing key; T, B, L, third brush line; M, L, main line; V, R, variable resistance; S. B, switchboard; R, resistance; F, C, L, field coil line; D, dynamo; V, voltmeter.

Tables 2 to 6 show (1) that with each position of the third brush, on increasing the external resistance, the current in the third brush circuit at first decreases, becomes zero, and again increases in the opposite direction; and (2) that the further the third brush is in advance of the positive, the higher is the current in the third brush line at first, the sooner the zero point is reached, and the higher the current rises in the opposite direction.

PLATE A.

Tables 7 to 10 show (1) that with advance of the third brush, the external current and resistance being kept constant, the E.M.F. continues to rise while the current in the third brush line gradually decreases, passes through zero, and again increases in a negative directon; (2) that this zero point is also the point of maximum additional resistance in the field, and of minimum additional resistance in the third brush line; and (3) that this zero point is reached sooner the higher the external resistance.

It was at first thought that these changes might be due to a distortion of the neutral line of the armature, since with each change in external resistance there was a corresponding change of strength of field, while the current flowing up through the armature from the negative brush remained constant. An exploration of the field, however, by the method alluded to, showed that under extreme variations of current in the field, the neutral line did not change position as much as 10° —an amount quite insufficient to account for the changes shown in the tables.

It will be noticed that the application of the third brush destroys the symmetrical flow of current in the armature. If the third brush be positive it will take off a part of the current flowing up on that side of the armature, and the coils lying between the third and positive brushes will have less current than the other coils. But if the third brush be a negative, the current returning to the armature by the third brush line will be added to the coils lying between the third brush and the positive. Neither will the current flowing up on one side of the armature be equal to that on the opposite side, since the resistances of the two paths offered to the current are not equal. The result of this unequal distribution will be, in extreme cases, to throw the neutral points of the armature off the ends of a diameter and on that side of a diameter where the coils are traversed by the weaker current. If, however, as was the case with the machine used in this investigation, the magnetic moment of the field is very great as compared with that of the armature, this effect is inappreciable.

But these variations of current in the third brush line may be satisfactorily explained without reference to the distortion of the diameter of commutation. It is a well-known fact that the total E.M.F. generated in the armature coils increases around the commutator from the negative brush to the positive, each coil adding its share to that induced in the coils preceding, and that the E.M.F. again falls, through the same range, from the positive brush around the external circuit to the negative brush.

Let E_d be the drop of potential between the positive brush and the point at which the third brush line joins the main circuit, and let E_t be the rise of potential between the third and positive brushes—that is, the E.M.F. induced in the coils which lie between these brushes.

It is evident that if $E_d = E_t$, no current will flow in the third brush line, its two ends being at exactly the same potential. But if $E_d > E_t$, the third brush will be at a point of higher potential than the other end of the third brush line, and current will flow *out of* the armature through the third brush. If $E_d < E_t$, the reverse effect will be produced, and current will flow along the third brush line *into* the armature.

Now $E_d = C'\,R'$, where C' and R' are respectively the current and resistance of that part of the circuit between the positive brush and the junction of the third brush line with the main line. Also:—

$$E_t = \frac{2}{\pi}\,w\,H'\,A'$$

$$= 4\,n\,H'\,A'.$$

A' being the "equivalent area" of the coils lying between the third and positive brushes; H', the strength of field; w, the angular velocity; and n, the number of revolutions per second of the armature.

There will be equilibrium between the ends of the third brush line when $E_d = E_t$, that is, when

$$C'\,R' = 4\,n\,H'\,A'.$$

The speed remaining constant, this equation shows that any one of three changes will make $E_d > E_t$, and so make the third brush positive.

(1) *Increase of* R'.

This will occur if the finger, *f*, diagram I., be moved toward the point B. This change will produce a corresponding decrease of C' and H', but below the saturation point these practically vary in direct proportion, and will not change the value of the equation.

(2) *Decrease of* A'.

This may be done by bringing the third and positive brushes nearer to each other, thus decreasing the number of coils between them.

(3) *Increase of* C', the field magnets being saturated.

If H' remain practically constant because of the saturation of the iron, an increase of C', caused by a decrease of the resistance of the external circuit, will make $E_d > E_t$.

The three opposite changes will make $E_d < E_t$, viz.:—

(1) *Decrease of* R'.

(2) *Increase of* A'.

(3) *Decrease of* C', the field magnets being saturated so that H' remains constant.

A change of speed, *n*, would produce a complex change in all of the factors, except A'. All of the variations of current in the third brush line may be traced to one or more of these causes.

DIAGRAM II.

It will be noticed that the difference of potential between the main brushes is always the same—between 50 and 51 volts—when the current in the third brush line changes sign. This is the point at which the new characteristic crosses the characteristic of the regular series machine, as shown in plate A, where the characteristic curves from tables 1 and 2 are plotted together. When the third brush is positive it robs the field coils of a part of their current, and adds this to the main line current, and when it is negative it diverts a portion of the current from the main line, adding it to the field circuit line.

It will also be noticed that curves plotted between field current and E.M.F. from tables 2 to 6, coincide with the characteristic from table 1. This would necessarily be so, since in table 1 the external current is also the field current.

No higher E.M.F. can be reached on the constant current curve than that obtained from the machine worked as an ordinary series dynamo, the limit being reached as soon as the iron of the field magnets becomes saturated.

The horizontal distance between corresponding points on the constant current curve and on the curve of E.M.F. with field current, measures the amount of current flowing in the third brush line at that point, and also shows whether it is positive or negative.

It is evident that the point of crossing of the two characteristics—that is, the point at which the current in the third brush line becomes zero, will depend upon the *amount* of the constant current in the external circuit. Tables 11 to 14 give the data obtained when the external current was held respectively at 1·0, 1·5, 2·0 and 2·5 ampères. The points obtained by plotting field current with E.M.F. fall, as before, upon a common curve, as shown in plate B, and the constant current curves for 1·0, 1·5, 2·0 and 2·5 ampères cross this curve at 38, 44, 47 and 47·5 volts E.M.F. A curve for ·5 of an ampère would cross the characteristic at about 22 volts.

Below the saturation point of the iron the relation between current in the third brush line and E.M.F. is one of direct proportion. When the saturation point is reached current in the third brush circuit may increase indefinitely without increase of E.M.F.

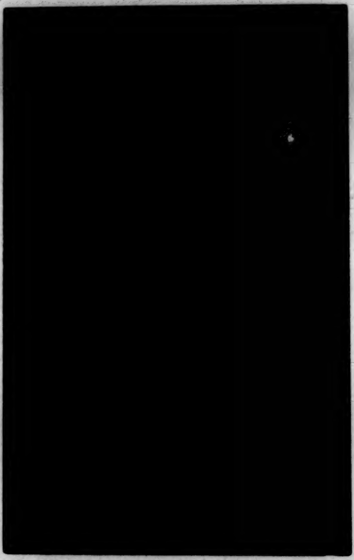

PLATE B.

No very large *negative* current is obtained in the third brush line until the third brush is 90° or more in advance of the positive. This would seem to indicate that the constant current characteristic cannot be carried much, if any, above the regular series characteristic unless the third brush has a very large lead, and this is objectionable because of very bad sparking at the third brush.

This arrangement is in reality equivalent to a compound wound dynamo in which one set of field coils is made to carry the current for both the series and shunt coils of the usual type of compound-wound machine. Referring to diagram I. and the last line of table 4, it is clear that the field coils act as *series* coils in carrying a current of 1·70 ampères from P, the positive brush, around the external circuit to the negative brush, N, and that at the same time they act as *shunt* coils in carrying ·65 of an ampère from P, around the field magnets and back to T, the third brush. There is, however, this further distinction to be made between this arrangement and the usual type of compound dynamo—that that part of the field current which partakes of the character of a shunt becomes zero under certain conditions of the external circuit, and that beyond this point the shunt circuit acts as a differential coil wound upon the field magnets. This is effected, not by an opposing current being sent around the field, but by the shunt becoming a *shunt around the series field coils*, thus depriving them of a part of the current they would otherwise receive, and so weakening the field. This is shown by the first line of table 4, where, of the 1·70 ampères in the external circuit, the field coils carry but ·35, while a current of 1·35 ampères is shunted around the field by the third brush line and added to the current in the main circuit. Though common enough in motors, the writer is not aware of any other case in which a differential coil, or anything analogous to it, is applied to a generator.

The arrangement then embodies at once the principles of three distinct types of dynamos, the types used being determined solely by the resistance of the circuit if the external current be kept constant. In keeping a constant external current, however, the resistance of the series field changes.

These three types are :—

1. Series dynamo + differential shunt coils (or rather what has the same effect as differential shunt coils).

This type is brought into use when the third brush is at a higher potential than the junction of the third brush line with the main line, and a portion of the total current of the armature is diverted from the field coils, decreasing the strength of field.

2. Plain series dynamo.

This is the type made use of when both ends of the third brush line are at the same potential, and the current flowing in it is *nil*, which occurs at the point of intersection of the two characteristics.

3. Series dynamo + cumulative shunt coils.

This occurs when the junction of the third brush line with the main line is at a higher potential than the third brush, and current flows into the armature at the third brush.

It should be noticed that in this combination the total resistance of what corresponds to the shunt circuit of the field, including the resistance of the field coils and whatever resistance may be placed between the third brush line and the field line, is a constant, while the resistance of what corresponds to the series circuit of the field is variable, being changed by the movement of the finger, *f*, diagram I., along the resistance, A B.

The requirements for constant potential regulation are radically different from those necessary for constant current. Recurring again to Professor S. P. Thompson's fundamental equation of the dynamo,

$$E = 4\, n\, A\, H,$$

where n and A are both constant, it is evident that if E is to be a constant, H must also be a constant. Hence, for constant potential regulation the exciting current of the field coils must be a constant.

It is believed that the method here described for obtaining this result has not before been applied for this purpose. The arrangement is a very simple one, as shown in diagram II. The third brush line passes through a low resistance, and is joined to the main line at the positive terminal of the machine, just outside the field coils. In this case either no resistance or a very low one is placed between the third and positive brushes, and no automatic arrangement is necessary, as the point of junction is a fixed one. Diagram III. shows the connections as used in the experimental work.

The effect of using different resistances in the third brush line is shown by tables 15 to 19, and curves 1 to 5, plate C, plotted from these tables. The third brush remained fixed at 36° in advance of the positive brush, this being given as before, 12° lead. Curve 6 of the same plate is plotted from table 20, and is the characteristic of the machine run as a series dynamo, reduced to the same speed as tables 15 to 19.

TABLE 20.

Volts.	Ampères.
8	·20
37 3	·88
48·2	1·48
51·6	2·22
53·5	3·06
56·2	4·53
59·0	5 83
57·2	6·50

Curves 7 to 11 of plate C are plotted from tables 15 to 19 with external resistances as abscissæ, and current in the third brush line as ordinates, and correspond respectively to curves 1 to 5. Negative current is plotted below the axis of X, and positive current above.

	Volts.	Ampères in main line.	Ampères in field line.	Ampères in third br. line.	Ohms in main line.	Ohms in third br. line.	Angular advance of third brush.
Table 15.	59·	·63	3·37	–2·74	80	Only the lead wire.	36°
	59·	·84	3·40	–2·56	60		
	59·	1·14	3·42	–2·28	50		
	59·	1·29	3·31	–2·03	40		
	58·	1·64	3·16	–1·52	30		
	57·5	2·00	3·12	–1·12	25		
	56·4	2·44	3·01	–·57	20		
	53·5	3·10	2·78	·32	15		
	50·	4·00	2·12	1·88	10		
	46·4	4·87	1·06	3·23	7·5		
Table 16.	57·	·68	2·95	–2·27	80	1	36°
	57·	·87	2·93	–2·06	60		
	57·	1·04	2·89	–1·85	50		
	56·5	1·24	2·88	–1·64	40		
	55·8	1·66	2·84	–1·18	30		
	55·2	1·96	2·86	–·90	25		
	54·8	2·40	2·86	–·46	20		
	53·5	3·08	2·80	·27	15		
	51·	4·40	2·83	1·57	10		
	48·5	5·40	2·82	2·58	7·5		
Table 17.	54·	·60	2·23	–1·63	80	2	36°
	54·	·81	2·30	–1·49	60		
	54·	1·01	2·32	–1·31	50		
	54·	1·19	2·37	–1·18	40		
	54·	1·55	2·46	–·91	30		
	54·	1·91	2·56	–·65	25		
	54·	2·37	2·69	–·32	20		
	53·5	3·09	2·89	·20	15		
	53·	4·40	3·33	1·07	10		
	52·	5·58	3·75	1·83	7·5		
Table 18.	52·5	·61	1·79	–1·18	80	3	36°
	52·5	·79	1·90	–1·11	60		
	52·5	·97	1·97	–1·00	50		
	52·5	1·17	2·05	–·88	40		
	52·5	1·55	2·19	–·64	30		
	52·5	1·90	2·37	–·47	25		
	53·	2·35	2·60	–·25	20		
	53·5	3·06	2·86	·20	15		
	53·	4·40	3·59	·81	10		
	52·5	5·52	4·22	1·30	7·5		
Table 19.	47·	·57	·91	–·34	80	5	36°
	48·5	·73	1·10	–·37	60		
	49·	·96	1·31	–·35	50		
	50·	1·17	1·53	–·36	40		
	51·2	1·53	1·80	–·27	30		
	52·0	1·88	2·11	–·23	25		
	52·8	2·28	2·40	–·12	20		
	53·5	3·06	2·96	·10	15		
	53·5	4·42	4·08	·34	10		
	52·3	5·46	4·88	·58	7·5		

These curves and tables show : (1) that the current in the third brush line is, at first, with high external resistances, negative, having its highest value when the external resistance is infinite, or when the main line circuit is open ; that with decreasing external resistances it gradually decreases, passes through zero, and again rises in the opposite direction ; (2) that the point at which the third brush current becomes zero is independent of the resistance in the third brush line, becoming zero in each curve at exactly the same external resistance, and that this zero point is the point at which the new curve crosses the series characteristic ; (3) that increase of resistance in the third brush line reduces the regulating power of the third brush, the curve at the limit coinciding with curve 6 ; (4) that increase of resistance in the third brush line decreases the field current, and consequently the E.M.F., but that the external current is practically independent of the resistance in the third brush line ; (5) that the most constant E.M.F. is produced when the third brush line has a resistance of about three ohms—in this case about twice that of the field coils. This resistance, however, will vary, not only with the resistance of the field coils, but also with the angular advance given to the third brush, and with the amount of current necessary to produce saturation—that is, with the quality and quantity of iron in the cores.

The explanation of these phenomena is slightly different from that already given for the changes observed in the case of constant current regulation. The same equation, however, is applicable. Using the same symbols as before, equilibrium will exist between the ends of the third brush line, when $E_4 = E_1$, or $C' R' = 4 n H' A'$. In this arrangement, R', which is here the resistance of the field coils only, remains a constant. A decrease of A', by bringing the third and positive brushes nearer each other, or, within certain limits, an increase of C', will make $E_4 > E_1$ and make the third brush positive. If now A' remains constant and C' be increased by a decrease of the external resistance, H' will increase in direct proportion as long as the iron of the field magnets is in the unsaturated condition, and there will be no change in the value of the equation, $E_4 = E_1$. But as soon as the saturation point is reached, H' becomes practically a constant, and further increase of C' will make $E_4 > E_1$ and the third brush positive. In tables 15 to 19 the field magnets are fully saturated when $E_4 = E_1$, and hence *any* increase of C' makes $E_4 > E_1$. Had A' been much smaller this result would not have been obtained.

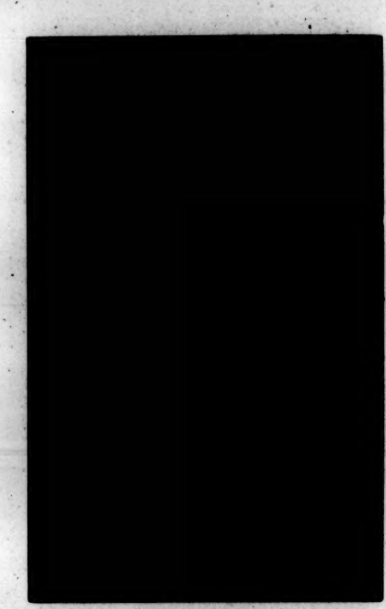

DIAGRAM III.

G, galvanometer ; R, K, reversing key : S, W, switchboard ; M, L, main line ; T, B, L, third brush line ; D, dynamo ; V, voltmeter.

The two opposite changes will make $E_4 < E_1$ and the third brush negative—viz., an increase of A', or a decrease of C'. A decrease of C', however, will produce this result only when, as before, the iron is fully saturated. This is shown in the first part of table 19, where the field current was not sufficient to produce saturation of the magnets, and, as a result, the current in the third brush line remains practically unchanged while C' undergoes considerable variation.

It is evident that the potential of the two extremities of the third brush line is independent of the resistance of the line, and hence any variation in this resistance will have no effect upon the point at which its two ends will be at equal potential. It does, however, determine the amount of current flowing in this line, and hence the amount flowing in the field coils ; since when the third brush is negative it adds its current to that of the field coils, and when it is positive the current in it is shunted *from* the field coils, as in the constant current regulation. This resistance must be low enough to allow of complete saturation of the field magnets.

Here, again, we have an arrangement which is, in reality, equivalent to a compound wound dynamo. Referring to diagram II. and the first line of table 17, it will be seen that the field coils perform the part of series coils in carrying ·6 of an ampère from the positive brush, P, around the external circuit to N, and at the same time, as shunt coils, carry 1·63 ampères from P around the field magnets to T, the third brush. The same three types of dynamos are here brought into use—viz. :—

1. Series dynamo + cumulative shunt coils.
2. Plain series dynamo.
3. Series dynamo + "diffential shunt" coils, and the conditions under which each is brought into use are precisely like those already met with in regulation for constant current.

PLATE C.

As was pointed out in the discussion of the constant current regulation, the application of the third brush necessarily interferes with the symmetrical flow of current in the armature, those coils lying between the third and positive brushes carrying more or less than the other coils, according as the third brush is negative or positive. In properly constructed dynamos this should produce no detrimental effect. It should, however, be taken into account in dynamo design when computing the size of armature wire from the amount of current it is to carry, for it is evident that in this case one-half the total current in the external circuit is not the maximum current which the armature coils must carry. A similar remark applies to the size of wire for the field coils.

A decrease of the resistance of the field coils would decrease the loss of potential between the positive brush, P, diagram II., and the point B, and, the potential of T remaining constant, would increase the negative current in B T, and, other things being the same, the lower the resistance of the field the lower the resistance of the external circuit must be made before B and T are brought to the same potential, or, in other words, before the new characteristic crosses the series characteristic; and if this point is not reached within the limits of the machine only the first of the three types of dynamos mentioned above is made use of. The same effect is produced by giving increased advance to the third brush, thus lowering its potential. Increased resistance of the field or decreased advance of the third brush will produce opposite effects. It will be found that whatever the field resistance or the advance of the third brush, there will be a corresponding resistance for the third brush line (and this in conjunction with the field coils may be regarded as the shunt circuit of a compound dynamo), for which the machine will produce a constant E.M.F.

Prof. S. P. Thompson has observed that the efficiency of any compound-wound dynamo for constant E.M.F. is very nearly a constant. Using his equation for efficiency, this is very nearly obtained from table 19 and curve 5, plate C, and this is probably very near the true curve for constant E.M.F. at the *terminals* of the machine, the volts here being the difference of potential between the brushes.

It is hoped that at some future time an experimental study, similar to that described above, may be made of third brush regulation for electric motors for both constant current and constant potential circuits. The field is an inviting one, and cannot fail to be productive of useful and practical results.*

Boston, Mass., November 17th, 1878.

EXPERIMENTS ON DEATH BY ELECTRICITY.

SOME experiments on the effect of electricity upon animals, with a view to determining the best method of inflicting the death penalty on capital offenders, were performed on the 5th of December at Mr. Edison's laboratory in Orange. Mr. Harold P. Brown was in charge of the work. The experiments are thus described by the *Scientific American*:

A calf weighing 124½ pounds was first subjected to the current. An alternating current of about 50 volts E.M.F. was first applied, which caused the animal to fall, but nine minutes afterward it rose to its feet apparently uninjured. The current was then brought up to 770 volts E.M.F., and was applied for eight seconds. The animal died, and, as far as could be ascertained, the death was absolutely instantaneous. On dissection the brain vessels were found filled with blood, but no hemorrhage was discernible; the heart and lungs were normal. The hair on the forehead was slightly scorched where the metal parts of the electrode came in contact with it.

A second calf, weighing 145 pounds, whose resistance between the electrodes was 1,300 ohms, was subjected to a current of 750 ohms E.M.F. for five seconds. Again death was instantaneous, the heart at once stopping.

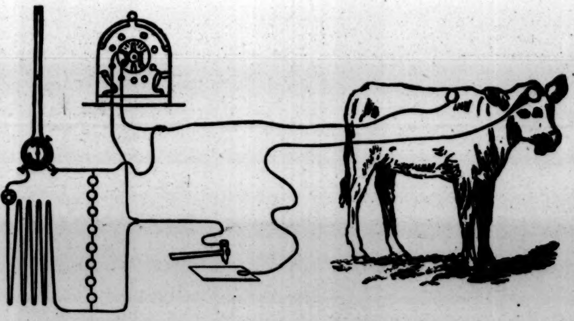

DIAGRAM SHOWING METHOD OF CONNECTING BATTERY AND SUBJECT.

Next a horse, weighing 1,230 pounds, halter included, was subjected to the experiment. With the connections made as shown in the cut, the resistance was found to be 11,000 ohms. The current was used at about the same potential as before, but, as the voltmeter had broken down, the electromotive force could only be judged by the degree of illumination which it imparted to a series of lamps. A single tap of the hammer was used to close the circuit, but the animal was little if at all affected. The current was then applied for 5 seconds, and again for 15 seconds, and in neither case was the animal injured apparently. Finally the current, at a full potential of 700 volts, estimated, was applied for 25 seconds. During this time steam was evolved from the electrodes, showing insufficient metal contact. Death was produced instantly.

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* From the Journal of the Science College, Imperial University, Japan, Vol. I.

The methods of connecting the wires to the animals were two: in the cases of the calves, ordinary medical electrodes were used. One was applied to the forehead, the other just back of the shoulders, in order to bring the brain into the direct line of conduction. The forehead electrode was circular, 2 inches in diameter, and was covered with sponge; the other electrode was 4 inches long and 2 inches wide. Both were covered with sponge, which was saturated with a solution of zinc sulphate of specific gravity 1·054 at standard temperature. A portion of the skin, where the electrodes were to be applied, was freed from hair by clipping with scissors. The burning of the hair in the first experiment was undoubtedly due to incandescent and not to arc action.

In the case of the horse, the legs were wrapped with wet waste, and around this the wires were wound directly. One conclusion that these and other experiments lead to is that the resistance of the animal is due in great measure to the perfection of the contact with the skin. Perspiration favours the contact and lowers resistance. Another conclusion is that the current should be applied so as to have the brain in its direct course. A distinct difference is noted between the action of the alternating and the direct current. The alternating current seems to produce a kind of paralysis or tetanic condition, in which the animal struggles very little, while the direct current brings about contortions which may become very serious and powerful.

The experiments were executed under the auspices of the Medico-Legal Society of this city. The importance of determining the best method of inflicting death by electricity arises from the new law of the State of New York, which goes into force after the 1st of January. This law substitutes death by electricity for death by hanging as the statutory punishment for capital offences.

The recommendation of the committee which, in September, had been charged with especial consideration of the question, advised the use of the alternating current of 1,000 to 1,500 volts E.M.F. and with alternations of not less than 300 per second. The current, the report stated, should enter the person by metal electrodes from 1 to 4 inches in diameter, covered with thick layers of sponge and chamois skin moistened with a weak aqueous solution of common salt, and the sitting position was recommended.

The measurements were made by Mr. A. E. Kenelly, of the Edison laboratory. It will be noticed in the diagram of the electric connections that a series of lamps were arranged in parallel with the voltmeter and its resistance. The lamps in this position acted as an adjunct to the voltmeter, giving ocular evidence of variations in electromotive force, and affording in themselves an approximate measurement of the same factor. They were utilised after the breaking down of the voltmeter as already described.

It is now proposed to kill an elephant by electricity, not, however, by the Medico-Legal Society's representatives.

Phonographic Messages.—The *Daily News* says:—"Mr. Raikes is faced at the Post Office with a new and unprecedented difficulty. Phonograms (messages in correspondence recorded by means of the phonograph) are impressed upon a thin cylinder of wax. These, placed in a wooden receptacle specially constructed, are in increasing numbers sent by post between the United States and this country. It is claimed that they shall go by the book-post rate. The Post Office authorities desire to class the despatches as letters with postage payable at letter rate. Correspondence on the subject is still in progress."

JACOB'S IMPROVED CABLE DUPLEX TELEGRAPH SYSTEM.

In order to obtain a perfect balance between the artificial and the actual cable, it is necessary that every electrical quality and circumstance of the latter should be reproduced as closely as possible in the former. Now, for better convenience in handling the traffic on a submarine cable, it often happens that the operating station is situated at some distance from the shore end of the cable, and connection to the latter is made by an underground wire or cable; and, further, a second underground wire or cable is used for the earth connection from the operating station, the earth being usually formed by the sheathing of the cable, though in some cases by a conductor between the station and the ground connection or sheathing of the cable, which conductor may be termed the "earth cable."

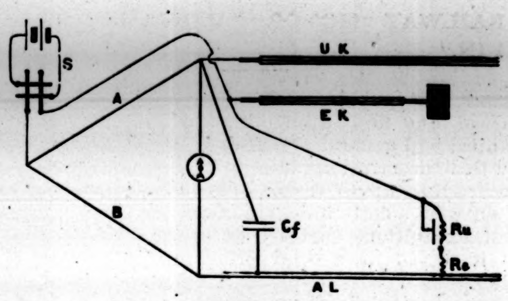

Fig 1.

In such a case Mr. Jacob introduces, for the purpose of establishing a perfect duplex balance between the earth armature or plates of the artificial cable and the end of the conductor of the earth cable at the operating station, an artificial line or cable similar in all its electrical qualities to the earth cable.

It has been usual to introduce a condenser with one of its terminals connected at some point along the bridge arms, and its other terminal connected to earth or to the earth cable, either direct or through a separate resistance, such resistance not forming part of any other circuit. The special improvement devised by Mr. Jacob, it will be seen, consists in connecting this last-mentioned terminal of the said condenser to the earth armature or plates of the artificial cable at that portion of the artificial cable which is connected to the bridge arm, so that this last-mentioned terminal of the said condenser is connected to earth through identically the same circuit as the earth armature of that portion of the artificial cable which is connected to the bridge arm.

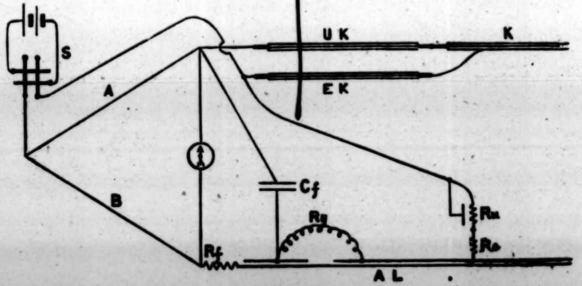

Fig. 2.

In figs. 1 and 2, S is the transmitting apparatus, U K is the underground cable, K the submarine cable, E K the earth cable, and A L the artificial cable.

A B are the arms of the electrical bridge or the coils of a differentially-wound receiving instrument.

R *n* is the artificial earth cable, R *e* a resistance representing that of the ground plate or ground connection.

R *g* is a resistance representing that of the soil which surrounds the actual underground cable.

C *f* is the condenser introduced between the bridge arm and the earth armature of that portion of the artificial cable which is connected to the bridge arm.

R *f* is a resistance which has sometimes been introduced for a final adjustment of balance.

EXPERIMENTS WITH THE DAFT ELECTRIC RAILWAY MOTOR "BENJAMIN FRANKLIN."

WHILE the public trials of the "Franklin" have received due and discriminating notice from both technical and general press, says the *Electrical World*, very little description has appeared of the preliminary tests leading up to them. They were naturally conducted with a certain degree of privacy, and the subsequent exhibitions so fully occupied public attention that it would have been premature to exploit them earlier.

They signify, however, so much more to the professional mind than the runs of November 25th and December 5th as to demand a special notice.

The qualities which it was necessary to demonstrate were: 1. Tractive capability. 2. Speed. 3. Mobility and handiness. Deliberate and exhaustive tests were applied, which are considered to have resulted in fully establishing the "Franklin's" excellence in these respects.

The tests for tractive capability were cumulative in their method and were abandoned only when the load drawn exceeded by 40 per cent. that which the motor was guaranteed to pull, and up to this limit there was not the faintest intimation of overload or strain of any kind. On the contrary, everything indicated that the motor was working well within its ultimate capacity, and its prompt, responsive action in starting, acceleration and stopping, was a surprise to the most sanguine.

The accompanying illustration shows how the load was applied. Eight empty cars were taken up the maximum gradient, nearly two per cent., at a speed of 7½ miles per hour, developing in so doing 120 H.P. Another achievement with this train consisted in backing it from the main line to a siding, and necessarily around the reverse curve connecting them, upon a gradient of 53 feet per mile.

The trials for speed under loads fell, on both occasions, upon the worst nights of the recent stormy weather, and, in spite of it, results were obtained equalling and exceeding the schedule speed of steam locomotives at ordinary service. With the standard trains of four cars and a little over half of the possible seated load, a speed of 15¼ miles per hour was obtained, an excess of two miles per hour over the regular steam traction speed, and this without effort or resort to ample means still available for its increase. On two occasions, with three empty cars, speeds of 30 miles per hour were obtained without taxing the motor in the slightest degree.

The free speed trials might have been carried to a much higher degree than they were, as the power limit was not nearly approached; but various considerations rendered it advisable to confine them to the specified conditions, the chief of which was an earnest desire to have the test continue to the end, as it was from the beginning, unattended by the slightest accident or disappointment. To this was added a strong unwillingness to trespass longer than indispensable upon the unstinted courtesy of the elevated railway officials.

On the point of mobility and handiness, a short anecdote will exhibit fully its completeness. During preliminary trials, while handling a train of six empty cars—a total load of 94 tons—it became necessary to shunt the train on a siding to permit the motor to be in front on the return trip. The standard train on the Ninth Avenue line is composed of four cars and the sidings are built of a corresponding length. In looking over the situation, before shunting, it was discovered that the siding was only four feet longer than the train, and great nicety of manipulation would be necessary to accomplish it, especially as the motor was unprovided with means for working the air-brakes, leaving the train entirely dependent upon hand-brakes worked by only two men. The attempt was made, however, and, by skilful handling of the motor and zealous use of the ordinary brakes, the shunt was successfully accomplished, the train coming to a complete stop within the narrow limit of four feet.

ELECTRIC SEARCH LIGHTS.

WE have on various occasions referred to the experiments which have been made with electric search lights in our Royal Navy, and also to the employment of the electric light on board our merchant vessels; but we very rarely, if ever, hear of its employment or even of trials made with it in connection with our land military forces. It is quite true that in some of our recent campaigns electric projectors have been used, but it is rather surprising that the Government does not take some steps with a view to the more general employment of the electric light in time of war. Some few weeks ago the Prussian military authorities conducted a series of trials with electric projectors during the darkness of night, and the results obtained—considering that various manœuvres were executed, and that firing both from cannon and rifles were carried on—were highly satisfactory. The Prussian authorities therefore expressed themselves greatly in favour of the employment of the electric light for war purposes.

Notwithstanding the fact that the attention of the British public, and also of the Government, was drawn to the subject at the time, the matter was coolly passed by with indifference. Now, however, the Russian military authorities have taken up the subject, and have just concluded a series of experiments at Viborg. The trials were undertaken for the purpose of determining whether the electric light can be advantageously employed in military operations, and whether it presents the inconvenience of revealing to the enemy the position of their opponent's batteries, &c. The following are the conclusions arrived at:—(1) The ground in front of the military force should be lighted for reconnoitring, for which purpose a very powerful and concentrated light should be used. The trials gave some excellent results regarding the influence of time, colour, state of movement or rest of the objects on which the light was projected when two projectors were concentrated on the same point, or when one of double intensity was employed. (2) It is necessary to take into consideration the distance within which one force under cover from the enemy can accomplish its work, both in and outside of its lines. (3) As regards the use of the light for the purpose of concealing the position of one body of men, trials were made in order to determine what effect blinding, by means of an intense light, could have on the enemy's gunners, and inversely, what effect could be produced on one's own gunners by the enemy's projectors. (4) Signalling operations were carried on. The general conclusions arrived at by the Russian military authorities are said to be greatly in favour of the employment of the electric search and other lights for military purposes. We would draw the attention of our English military authorities to the above two cases in the hope that we may not remain in the background as regards the use of electricity, as has been the case with many other things which we have only found out when it has been too late.

NOTES.

Central Station Lighting in Liverpool.—The Liverpool Electric Supply Company has now in operation three central stations, situated respectively in Lime Street, Tithebarn Street, and Harrington Street. The whole of the leading business portion of Liverpool is included within an easy radius from the above stations. The company is laying down a complete system of underground mains under the provisions of the Board of Trade licence, which it has recently obtained with the assent of the Corporation of Liverpool. Nearly the whole of the leading insurance offices and banks, and many other business premises are now supplied with the electric light from the company's stations. The light is available from 8 a.m. to 10 p.m., and the company is making arrangements by which it will shortly be able to give a continuous supply. The total number of lamps connected with the company's supply wires is between 3,000 and 4,000. The company is now engaged in making considerable additions to its central stations and plant, to enable it to deal with the increased demand which is anticipated as the laying of the underground mains proceeds.

Electric Lighting at Woolwich.—We learn that the Government has ordered 20 "Brockie-Pell" arc lamps for the lighting of the new saw mill at Woolwich Arsenal. Forty of these lamps have been used in the torpedo factory for nearly three years and they must therefore have been amongst the first made by Messrs. Johnson & Phillips, as the patent dates from November, 1885.

Accumulator Lighting in the States.—Mr. E. I. Mason, engineer of the Woodward Electrical Company, Detroit, Mich., has installed a plant of 31 Detroit accumulators at the laboratory of Prof. Elisha Gray, Highland Park, Ill. He is now increasing the plant of the central station, Petoskey, Mich., by the addition of 125 cells of the large type. The total accumulator plant will amount to 300 cells capable of supplying 500 Edison lamps of 16 C.P. for a period of 10 hours.

The Electric Light in Bishop Stortford.—During the last week or so circulars have been sent to the principal consumers of light in Bishop Stortford stating that it is proposed to form a local company for supplying current for electric lighting and distribution of power in the town. The capital proposed is £10,000 in £5 shares; only half of this sum would be called up at first, the remainder after an interval of not less than 12 months. A London firm of electrical engineers has offered to supply the machinery and plant required, and is willing to accept fully paid up shares to the extent of 50 per cent. of the price in part payment and the remainder in cash. This, it is argued, would ensure their taking every precaution to make the affair a success. Current would be supplied to consumers either by meter at the rate of 7d. per Board of Trade unit, equivalent to gas at about 4s. per 1,000 cubic feet, or at fixed annual rates per lamp.

Electric Light in Madrid.—We are informed that the electric lighting of the Calle del Principe, in Madrid, has given great satisfaction. This is the first street in Madrid thus illuminated, and much praise is merited by the business firms of the locality, to whose energy and perseverance the successful establishment of the new illuminant is entirely due.

Paris Lighting.—Although the tenders for the steam engines and electric machines for the lighting of the Halles were deposited some six weeks ago at the municipality the results of the awards are not yet officially published. If a corresponding amount of time is required for all the other matters connected with this installation, it is safe to predict that the district of the Halles is as yet some distance from possessing the electric light.

Street Lighting in New South Wales.—We are informed that a considerable number of "Brockie-Pell" arc lamps are on their way to Australia for the purpose of lighting the streets of one of the principal towns in New South Wales.

Electric Light and Printing.—The printing establishments of Chicago have introduced a novel form of electric lighting. Each workman carries a head-dress which contains an incandescent lamp, and a small cell capable of giving 10 hours of lighting without being re-charged. The whole apparatus only costs about $2.

Electric Light and the Stuart Exhibition.—The exhibition (in the New Gallery, Regent Street) of paintings and other relics of the Stuarts has, so far, been lighted by gas, but owing to the extreme heat of the rooms when largely attended, and also in the interest of the pictures, the electric light will probably be introduced without delay. The proximity of the Grosvenor Gallery and its works ought to render this change an easy matter.

Electric Lighting in France.—The electric light appears to be making considerable progress in France, even in the smaller towns. On Sunday the inauguration of the lighting of the streets of Valréas (Vaucluse) by electricity was publicly celebrated.

Philadelphia Street Lighting.—In the streets of Philadelphia there are 16,945 gas, 854 electric, and 5,297 gasoline lamps.

German Telegraph System.—The German Administration has just opened its 10,000th telegraph office. On the 1st January, 1876, when the posts and telegraphs of the German Empire were united under one single administration, the State only possessed 1,945 offices.

New Telegraph Stamp.—Tuesday, January 1st, saw the issue in Belgium of a new telegraph stamp of 25f. (£1). This stamp bears the King's effigy, and is printed in green on a red ground.

The Indian Telegraph Service.—It is stated that Sir A. Cappel, Director-General of Telegraphs in India, is coming home and intends to resign his appointment. He was properly trained in the service in India, but it is rumoured that a gentleman who has not been so trained will be selected for the vacant post.

Electric Traction by Accumulators.—We hope that within the next few weeks some tramcar experiments will be made in the metropolis with accumulators quite different in their constituent parts to those hitherto employed. Lead does not enter into their composition, nor is there any acid in the electrolyte, and their weight for a given amount of work is said to be considerably less than anything previously tried. A well known authority on electrical traction has expressed his absolute belief in the immediate success of electric traction by means of these accumulators, for one of the drawbacks to the known types of secondary cell when used for the purpose, viz., the jolting of the car, is very beneficial to the working of the coming batteries, more especially during heavy discharge.

Fusible Cut-outs for Telephones.—Mr. A. A. Campbell Swinton has sent us a letter on this subject, but too late for publication. He argues that it is a matter of little consequence whether the electric light or the telephone wire is the real offender, therefore it is very much to the interests of the electrical profession, and to the telephone companies themselves, that the slightest danger of fire should be guarded against in every possible way. The timid householder, whose telephone bursts into flame, is not likely, says our correspondent, to trouble himself to consider who is in fault, but will probably order the removal altogether of the instrument.

The Differential Calculus.—Professor Perry proposes to give a working knowledge of the Differential Calculus in a special course of 12 lectures and exercise work to electrical and mechanical engineers who have only an elementary knowledge of algebra and trigonometry. It may perhaps be regarded as a hopeless attempt to accomplish in 12 lectures that which is proposed, but the Professor is very hopeful of success if his attempt is sufficiently well made known to those men who so often grow disgusted when they see a sign of integration or of differentiation, and yet who are continually using the ideas of the Calculus without knowing it. The first lecture will be given at the Finsbury Technical College on the 15th of January.

Telegraph Manufacturing Company. — At the Britannia Telegraph Works, Helsby, near Warrington, the year 1888 has been one of increasing prosperity. Nearly 7,500 miles of insulated wires have been turned out during the year, including gutta-percha covered, India-rubber, silk and cotton. Vulcanised rubber electric leads, for which the company has special plant, are said to be in great demand, the shops now working overtime. The company has during the year made over a thousand railway instruments, also a large number of instruments for the postal telegraphs, including automatic bi-polar relays, sounders, keys, single needle tapper commutators, &c. Domestic apparatus has also been sold in large quantities, the company having special facilities for turning out work of this class. The new patent magnetos are in great demand, as also telephone material generally. The other departments, battery and insulator, have been constantly employed throughout the year.

Calendars.— The Anglo-American Brush Electric Light Corporation has issued a useful sheet calendar for the office walls of its friends and customers. It is most artistic in design, and appropriately represents the advent of electric lighting throughout London. Other useful calendars have been received from the Commercial Cable Company, and the Direct United States Cable Company.

The Woodhouse and Rawson Incandescent Lamp.—From an advanced proof of Messrs. Woodhouse and Rawson's new catalogue, we learn that continuous and lengthy experiments during the last few years have led to the production of an entirely new type of carbon, which is of such high quality that flashing is unnecessary. Filaments made from the usual materials and flashed are said to be, in comparison, soft and full of flaws, the nature of the flashing process inevitably causing the filament to consist of at least two, and, probably, of many different densities of carbon. It is further stated that the same care has also been taken to improve the many other processes by which the lamp is completed, every possible precaution being used to produce a lamp of uniform excellence.

Another Electric Railway Scheme.—Notwithstanding the fate of the projected electric railway under Hyde Park from South Kensington to Edgware Road, another scheme of the same kind is to be promoted in the coming session of Parliament. The route in view is not the same, being from the junction of St. James's Street with Piccadilly, thence under Piccadilly and Shaftesbury Avenue to High Holborn, and onwards to the western end of Holborn Circus, where the line will finish—for the time being, at all events. The railway, which is to be named the London Central Subway Railway, will be worked by electricity, the gauge of the lines being 4 feet 8½ inches. Special provision is to be made for ensuring the safety of the buildings and roadways overhead; and as there will be no trouble as to steam and "noxious vapours" ascending from the subway, the measure should have a fair chance of success. Certainly an underground railway between the points named, with of course several stations *en route*, would be of immense public advantage.

Réunion.—On Friday evening, 28th December, the friends and workmen of McWhirter, Ferguson & Co., Faraday Electrical Works, Glasgow, held their annual réunion in the Hall, St. James's Street, when over 50 sat down to a sumptuous repast. The chair was occupied by Mr. McWhirter, who, after tea, addressed a few remarks to the company on the rise and progress of the Faraday Electrical Works during the last five years. An assembly followed, dancing being kept up till well on in the morning.

New Edison-Swan Price List.—The Edison-Swan Company has sent out a new price list, dated 1st January, 1889, of incandescent lamps and holders.

A Year's Work.—During the past year Messrs. M. Immisch & Co. have been steadily increasing their business. There has been an increased demand for motors for isolated installations, but motors used in connection with central stations do not yet seem to be necessaries. This, however, will probably be altered as the number of central installations increases. The firm has given particular attention to motors for mining purposes, and three plants are ready for erection now—one in Yorkshire (a repeat order), one in South Wales, and one in Scotland. Experiments have also been made with a self-contained locomotive at Wharncliffe Silkstone Colliery, Yorkshire; the results are very promising, and seem to argue well for this class of traction. Attention has also been given to the applications of motors to launches, and considerable progress has been made. At Henley last year the firm had a 30 feet launch called the *Malden*, and since then they have placed on the river the *Viscountess Bury*, a superbly fitted pleasure boat 65 feet long, 10 feet beam, with a mean draught of about 3 feet. This latter launch is specially designed for the accommodation of pleasure parties. She is fitted with twin propellers and motors, and will make about 6 knots an hour for some 10 to 12 hours. It is intended to place on the river a fleet of about 8 to 10 launches (most of which are now building) in the early part of the year, and they will be let out on hire to pleasure parties. For the purpose of charging the accumulators charging stations are being established at several points on the river, and there are two floating stations which can be moved to regattas or wherever they may be required. Messrs. Immisch have supplied the 5 motors used on board the Spanish submarine boat, the *Peral*, and they have also supplied the dynamos for charging the accumulators used for storing the energy. The firm has also been engaged with tramcar motors, several of which have been made for foreign orders. Six of these motors are being supplied to the E. T. Company for use on the North Metropolitan line between Canning Town and Barking, and a dynamo of special design has been made for charging the accumulators for the six cars. It is expected that the whole will be running by the middle of January. A fair number of dynamos have also been supplied by the firm for incandescent and arc lighting both at home and abroad. There has also been a considerable increase in the general work of the firm, and orders have been received for many new applications of motors, upon which Messrs. Immisch & Co. may well be congratulated.

New Baronet.—The Queen has been pleased to confer a baronetcy of the United Kingdom upon Sir Frederick Bramwell.

The Copper Syndicate.—It is rumoured, says the *Evening Post*, that Messrs. Matheson & Co. are going, early in the new year, to try to float a company here, with a capital of £4,000,000, for the purpose of relieving the French Copper Syndicate of its intolerable load of unsold and unsaleable copper.

Reduction of Copper.—At the metal works of Madelburg, near Wiener Neustadt, copper is extracted by the electrolytic process. The copper thus obtained is exceedingly pure and possesses a conductivity much higher than that of copper produced by any other method.

City and Guilds of London Institute Old Students' Association.—The next meeting will be held at the Central Institution, Exhibition Road, S.W. (near South Kensington Railway Station) on Wednesday, January 16th, 1889, at 7.45 p.m., when the following paper will be read :—"The Design of Electro-Motors," by Albion T. Snell (Member). In consequence of the increased secretarial work the committee found it desirable to recommend to the Association the election of an additional secretary. At the meeting of December 18th, Mr. F. W. Le Tall, 14, Garfield Road, Lavender Hill, S.W., was elected to the position. The question of the further issue of a journal has been under consideration for some time past and it was finally resolved at the meeting of December 18th to bring out jointly with the Central Institution and the Technical College, Finsbury, a journal to represent these colleges and the O.S.A.

The "Peral."—We learn that the Spanish submarine torpedo boat, the *Peral*, will be very shortly submitted to the official trials. These are to be somewhat on the following plan. After leaving Cadiz Bay the *Peral* will be submerged and will experiment with her torpedoes on a wooden hulk. She will then return to the surface and proceed to the Straits of Gibraltar, where she will be again submerged, in order to test her performance when under the influence of strong currents. These experiments completed she will make for Malaga. If this trial turns out satisfactorily a much longer trip will be undertaken.

The Phonograph at Olympia.—Demonstrations with Edison's phonograph are to be given at the Winter Exhibition, Olympia, on Mondays, Wednesdays and Saturdays.

The Practical Uses of Electricity.—In the lecture-hall of the Church of England Young Men's Society, at Norwich, on the 20th ult., Mr. Paris, of the firm of Laurance, Paris & Scott, electrical engineers, gave a very interesting lecture on the subject of "Electricity in our Homes and Workshops." The hall was lighted by electricity, and every variety of electrical apparatus was fitted up on the platform, and explained by the lecturer, whose partner, Mr. Scott, assisted him in the practical demonstration of the uses of the appliances.

Fire from an Incandescent Lamp.—The New York *Progressive Age* reports that on November 19th, at the Hoffmann House, in that city, an accident of a unique character came near causing a panic. As the head waiter and his force were preparing the ladies' dining room for dinner, the carbon in one of the incandescent globes became twisted out of shape, the globe was broken and the artificial flowers with which the chandelier was decorated took fire. The flames rapidly shot up to the ceiling and damaged the frescoing, but the appearance of the hotel engineer, Mr. Walton, soon stopped the damage.

Electricity in the Royal Navy.—An intimation has been received at Portsmouth to the effect that in view of the development of the electrical department of the dockyard the Admiralty have decided, with the sanction of the Treasury, to create Mr. D. W. Lane, the present head of the department, "electrician of the dockyard" at a commencing salary of £220, to be raised by instalments, at stated intervals, to £300. Mr. Lane's connection with the electrical staff, of which he is now formally appointed chief, extends over a period of 16 years. From our own knowledge of Mr. Lane we do not hesitate to say that "My Lords" have secured a bargain advantageous to the Admiralty in every respect.

Instructions have been received at Portsmouth for certain naval officers to make themselves acquainted with the working of the Elliott's patent electrical engine room telegraph, which has been fixed in a shed near the electric shop, with the view of embodying their opinion of the same in a report to the Admiralty.

Sprague Electric Railways.—The Sprague Company reports November to have been a very busy month. The Brooklyn branch of the Boston West End Railway was completely equipped and ready for working. The electric railway installed by the company at Akron, O., went into operation, and gave general satisfaction, petitions being sent in for extensions. About the same time the new railway by the same company at Davenport, Iowa, started running, and such was the confidence of the directors of the line in the electric motors that they immediately offered the whole of their horses for sale. The lines at Wilmington, Del., and Wilkesbarre, Pa., reports show, have been working successfully, and at St. Joseph, Mo., where a heavy snowstorm occurred early in the month, the electric railway triumphed over all difficulties, running regularly without stoppage. Work is being pushed forward rapidly at Scranton, Pa., and Cleveland, O.

Automatic Street Fire Alarm.—Mr. George Durham, electrician, Stockport, has just completed for the Stockport Corporation a service of electrical street fire alarms. There are twelve of these alarms in Stockport, and a practical inspection of them made by a committee of the corporation has proved them to work with eminent satisfaction. Signals were sent from each, and responses were received in from three to six minutes. Should the system continue to act satisfactorily the alarms will probably be increased in number.

Weymouth and the Telephone.—A meeting, presided over by the mayor, was held at Weymouth recently to consider what course should be adopted in consequence of the decision of the Western Counties and South Wales Telephone Company to shortly close the Weymouth exchange unless there is a considerable accession to the list of subscribers. It was imperatively necessary, if the system was to be continued in the town, that at least 16 additional connections should be registered before the end of last month. A resolution urging upon the inhabitants the importance of supporting the telephone company and suggesting to the latter the advisability of quoting a lower rate than £10, was unanimously carried.

The Telephone in France.—The use of the telephone is largely increasing in France. In Paris, for instance, on account of the great progression in the number of subscribers and in telephonic communications, the Administrative Council of the Société Générale des Telephones have decided to introduce into the *matériel* of the central offices and in the subscribers' posts various improvements with a view to accelerating the putting of subscribers into communication with each other. These works are now in active operation, and will be shortly completed. This will also necessitate the augmentation of the staff.

Telephone Amalgamation.—The *Pall Mall Gazette* announces that "the long-protracted negotiations for the amalgamation of the telephone companies are now making satisfactory progress, and there is a near prospect of the union of the United, National, and Lancashire." This, says the *Financial News*, confirms our view, recently expressed, that any proposal to include the smaller companies in a scheme of amalgamation was premature. Our contemporary's announcement may be regarded as semi-official, because, after an allusion to the probability of an early completion of the trunk wire to Birmingham, it goes on to say: "Perhaps this contract with the North may induce Londoners to copy their provincial friends in the free use they make of the telephone." The suggestion that Londoners require any inducement to use the telephone, provided the management was satisfactory, could only have emanated from Oxford Court, where, in spite of all the blunders of the past, and the failures which have resulted, Mr. Morgan, the managing director, remains supremely unconscious of his own shortcomings.

Queensland Telegraphs.—The report on the Queensland telegraph system, for the current year, gives the number of miles of telegraph line as 9,037 with a length of conductors of 16,448 miles. The telegraph offices open to the public are stated as 293. We notice that the expenditure on the telegraph and telephone systems exceeds the receipts by about £27,000.

The Telephone in Bristol.—The city of Bristol is remarkably well served with telephonic facilities, being the centre of a large number of trunk lines, enabling its merchants to converse freely with Bath, Gloucester, Newport, Cardiff, Swansea, Pontypridd, &c. During the past month of November 30,028 trunk line messages or conversations were recorded, at an average cost to the subscribers of 1·56d., or a trifle over three half-pence a conversation. To be enabled to converse freely between Bristol and Cardiff for three half-pence per 100 words does not seem, to the subscribers at any rate, a dear operation, but among the subscribers are those who use the wires 500, 600, and in one case over 800, times a month, in which cases the cost to the subscriber is less than a farthing a conversation.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Chatham, Rochester and District Electric Lighting Company, Limited.—This company has notified the Registrar of Joint Stock Companies that by a resolution of the company dated 13th ult., the nominal capital has been increased by the addition thereto of the sum of £40,000, in 8,000 shares of £5 each, beyond the registered capital of £10,000.

South of England Telephone Company, Limited.—At an extraordinary general meeting of this company, held at 50, Old Broad Street, on the 22nd November, resolutions were passed authorising certain alterations in the articles of association of the company, and at a meeting held on the 12th ult. the said resolutions were confirmed and were duly filed on the 28th ult. The alterations are as follows, viz:—At the end of Article 11 the following words be added—"Provided also that no call shall exceed one-fourth of the nominal amount of a share or be made payable within two months after the last preceding call was payable." Article 15 is repealed and the following substituted:—"The transfer of any share in the company shall be by deed or deeds on the usual common form of transfer. There shall be paid to the company in respect to the registration of any transfer or transmission such fee, not exceeding 2s. 6d., as the directors deem fit." The words "not fully paid up" are inserted after the word "shares," in Article 17, and also after the words "the company shall have a first and paramount lien on all shares in Article 21. In Article 40 the word "tenth" is substituted for "fifth," and in Article 98 the words after "clauses" are omitted.

Railway and Domestic Electric Lighting Company, Limited.—The annual return of this company, made up to the 24th ult., was filed on the 27th ult. The nominal capital is £6,000, in £10 shares, the whole of which has been taken up. The full amount has been called and paid on 240 shares, and 360 shares are considered as fully paid. Registered office, 34, Great St. Helens.

Maxim-Weston Electric Company, Limited.—On the 29th December this company notified the Registrar of Joint Stock Companies that at the meetings of the company held on the 3rd and 21st December, it was resolved to wind-up voluntarily, and to appoint Mr. John Marks, of 113, Great Russell Street, W.C., Mr. J. M. Klenck, 42, Bishopsgate Street Within, and Mr. Louis Swaby, 23, Churchfield Road, Ealing, as liquidators for the purpose of such winding-up.

Taunton Electric Lighting Company, Limited.—An agreement of 4th ult., filed on 29th ult., entered into by this company with Messrs. C. J. Wharton, F. J. Down and A. F. Davies, of 82A, New Bond Street, electrical engineers, called the vendors, states that by an agreement of 19th March, the vendors agreed to supply electric apparatus on the Thomson-Houston system, and to accept half the amount of the price thereof in fully paid shares, and the balance in cash. The company being indebted to the vendors for £640 for a dynamo and 24 lamps and apparatus, did, in payment of £320 of the said amount, allot fully paid shares. By a mistake, a contract in writing was not filed as required by the Companies' Act, 1867, before the issue of the said shares, and the vendors having required the company to rectify the mistake, the company therefore cancels the said allotment, and in lieu thereof will, with all convenient speed, issue 64 other fully paid shares of £5 each.

British Electric Tramways and General Syndicate, Limited.—An agreement of 21st December, filed on the 29th ult., states that Mr. J. W. W. Haynes has rendered valuable services to the company in its formation and promotion, and the company therefore allot him 50 fully paid founders' shares of £5 each, and will pay to him £250 in cash.

NEW COMPANIES REGISTERED.

E. Page and Company, Limited.—Capital £30,000 in £1 shares. Object: To take over the business of agricultural, mechanical, marine and electrical engineer carried on by James Woodward Hill, trading as E. Page & Co. at Bedford and at the Bedford Iron Works, Kempston. The whole of the shares are taken by the following signatories:—Mrs. Louisa Hely, 40, Montpelier Street, Knightsbridge; B. H. Claxton, Kempston; Miss F. E. Hill, Bedford; *E. Fisher (engineer), Bedford; *E. D. Rabbitt, Bedford; *J. H. Darlow, Bedford; 50 shares each; *J. Woodward Hill, 22, Kimbolton Road, Bedford, 29,700 shares. The signatories denoted by an asterisk are the first directors, qualification 50 shares. Remuneration, chairman, £100 per annum; each director, £50 per annum. Registered 28th ult., by Crossman and Pritchard, 16, Theobald Road, W.C.

Electro-Galvanic Machine Company, Limited.—Capital, £3,500 in £1 shares. Object: To acquire the letters patent No. 13,326, dated 1st October, 1887, granted to John Douglas and Hy. Abbott for improvements in machinery or apparatus for producing and administering electric shocks and currents and for exhibiting advertisements. Signatories (with 1 share each): A. H. Turner, 121, Pall Mall; A. Jameson Waterlow, Ilford Park, Essex; H. Skinner, Hall View, Highgate; M. W. Naylor, New Southgate; B. W. Frost, 73, Central Meat Market; J. E. Renardson Grosvenor, Lordship Park, N.; H. R. Armstrong, 3, Great Winchester Street; and L. Green, Wallington. Registered 1st inst., without articles of association, by J. Wheatley, 23, Leadenhall Street.

The West Coast of America Telegraph Company, Limited.—The directors have declared a dividend of 6s. per share for the half year ending 31st December, 1888, payable on the 7th January.

Reuter's Telegram Company, Limited.—It is announced that the Hon. Mark Francis Napier has accepted the vacant seat at the board of this company.

TRAFFIC RECEIPTS.

The Western and Brazilian Telegraph Company, Limited. The receipts for the week ending December 28th, 1888, after deducting the fifth of the gross receipts payable to the London Platino-Brazilian Telegraph Company, Limited, were £3,464.

The Direct Spanish Telegraph Company, Limited The estimated receipts for the month of December were £1,908, against £2,004 in the corresponding period of last year.

The Brazilian Submarine Telegraph Company, Limited. The traffic receipts for the last week amounted to £4,164.

ROYAL E. HOUSE, THE ELECTRICIAN.

IN a pleasant home in the city of Bridgeport, writes H. C. Hovey in the *Scientific American*, lives a veteran inventor, whose name has long been associated with the honoured names of Henry, Morse, Vail, and other pioneers of telegraphy, and which has lately gained new publicity from the fact that he contests with Prof. Bell the priority as inventor of the telephone. Keenly watchful of passing events, he has hitherto been unwilling to allow any sketch of his life and services or any portrait of himself to be published; and it is only at the urgent request of his friends that he permits the printing of this communication.

Royal Earle House was born in Rockingham, Vt., September 9th, 1814. In 1840 he invented and put in operation a water wheel that would work under water and not freeze in winter, and yet do the work of a gravity wheel with its gearing. This he accomplished by using a spiral conduit, with cover, enclosing a vertical wheel with two sets of buckets; one set arranged around its side, to have motion from the inflowing water, the other arranged to cover the bottom, each bucket having a suitable angle to utilise the centrifugal force of the whirling water, and its weight, by causing the water between the vertical buckets to move backward and be discharged in a direction nearly opposite to that of the water in the spiral conduit, when, relatively, the outflowing water is in a state of rest. The principle of the turbine wheel had long been known abroad; but House's invention lay in such a combination of the impulse and discharge as should make the wheel of practical value, and his ingenious contrivance is now extensively used in various forms and known by different names.

In 1842 he resolved to devote his life to the study of electricity, and to give popular lectures, with accompanying experiments. After a brief career in the lecture field he decided, however, to limit his attention to the more promising arena of invention. A brilliant galaxy had already preceded him. Morse had taken out his earlier patents, but had not yet built the first electro-magnetic line—from Washington to Baltimore—when House conceived the idea of his printing-telegraph. He made his first instrument of the kind in 1844, and exhibited it before the Mechanics' Institute, in New York City. It received a gold medal from the American Institute in 1848, with a special compliment on its being "an invention of great ingenuity." The committee of award were Profs. Agassiz, Chilton, and Renwick. Morse's telegraph conveyed intelligence by preconcerted signals, dots, and lines made by breaking and closing the circuit. House's telegraph printed its messages in Roman letters. The component parts were type wheels, platens, a keyboard like that of a piano, and a single line of telegraph. The type wheels moved synchronously by a step-by-step motion, arrested at will by pressure on a key, causing its representative letter to be printed. The actual speed attained was at the rate of 50 words a minute, or equal to the average speed of the modern typewriter. This was more rapidly than work could be done by the Morse instrument; but the printing-telegraph required more power to move the type wheels, &c., which became an objectionable feature when stations came to be multiplied.

Prof. House removed with his family to New York City in 1844, and sold a half interest in his invention to Mr. William Ballard, who was financially associated with him in making instruments and laying lines. Hon. Samuel Selden and Mr. Hiram Sibley, of Rochester, were also interested. Mr. Henry O'Reilly made an agreement for the use of the printing-telegraph throughout the West. He located the first telegraph line of any sort between Pittsburg and Cincinnati. Afterward he located an instrument at New Albany, Ind.

Capital was subscribed for building a line from New York to Philadelphia. This line crossed the North River at Fort Lee. On the east side was a mast 300 feet high, and on the Palisades, on the west side, one 200 feet high, making an eminence 400 feet in height. The contractors had faith in a small wire cable of seven twisted strands. But in practice this gave much trouble, and a solid wire had to be substituted. The right to use the printing-telegraph between New York and Philadelphia was sold for $25,000 in stock, and for $30,000 the right from New York to Boston.

An arrangement was next made with Judge Selden and Mr. Edson to extend the invention to all the principal cities of the United States, and to build 600 miles each year, or to forfeit $10,000 to liquidate annual damages. Under that contract a line was built from New York to Buffalo, with an iron wire having 600 pounds to the mile, for which the patentees received $100,000 in stock. About that time the Morse company filed a bill for an injunction to stop the House line from New York to Boston. Up to that date all suits had gone in Morse's favour, and it was confidently expected that the injunction would be granted. The counsel employed on the House side were George Gifford, Rufus Choate, and Charles L. Woodbury. After hearing very exhaustive testimony, the judge decided that the House telegraph was no infringement. The favourable termination of that suit (which was never appealed) gave value to the invention.

A new era was introduced in telegraphy when the messages came to be received by *sound only*, the operator writing them off rapidly in a suitable form for delivery. Professor House saw the need of more sensitive apparatus for the transmission of sound waves. Taking up the subject where Bourseul and Reis had discontinued their researches, he made and had patented an "electro-phonetic telegraph," June 27th, 1865, and in order to improve the workings of certain parts took out another patent, May 12th, 1868. The invention consisted in placing at each station of the line a hollow ear piece for receiving sound waves, this being closed at one end by a thin flat plate, or diaphragm, having a spring force to counterbalance the magnetic force of the armature, and thus hold the sounding head in a state of magnetic equilibrium when the circuit is closed. There was also a device for adjusting the loudness of sounds.

The inventor's idea was simply that of making an instrument of great sensitiveness for receiving the sound signals of letters used in telegraphing. But the instrument is really a *telephone*, doing as good work as can be done by the more recent Bell telephone. The Supreme Court has decided that "a patentee is entitled to all the benefits which result from his invention, whether he has specified all the benefits in his patent or not." Hence Prof. House justly regards the Bell telephone as an infringement on his patent, and has called the attention of the American Bell Telephone Company to his claims. It is not my intention here to argue the case, but merely to state the facts as given to me. I may add that, in company with others, I have experimented with the original "electro-phonetic telegraph," made exactly according to the patent drawings, and with the modern House telephone, and also with the Bell telephone put in connection with the House, and found no difficulty in transmitting and receiving local messages with entire and uniform clearness. The inventor specified in his patent of 1868 that diaphragms as large as 8 inches might be used. To test this Prof. House produced a pair, of the size stated, made of pine wood, and the result was most remarkable. The messages were distinctly audible when the speaker and hearer each stood 5 feet away from the instrument; and when several persons carried on a conversation in the room, it was all transmitted perfectly to the other end of the line. Let the reader note the fact that every detail of the mechanism of these extraordinary telephones were covered by the House patent of 1868, granted eight years prior to the Bell patent of 1876, and observe the remarkable fact also that neither House nor Bell specially claimed that their instruments could "talk."

The "automatic telegraph" remains to be described in recounting the services of this eminent inventor.

When business increased so that many million messages went over the wires every year, it became evident that there must be a wasteful multiplication of poles, wires, instruments and operators, or else that in some other way the cost of sending a telegraphic message must be reduced to a minimum. House undertook to meet this demand by a system of his own. He invented a new, time-saving alphabet, in which a message may be prepared for transmission. When thus prepared it is sent over the wire with greatly augmented rapidity, and is transferred from line to line without having to be repeated. "Untouched by an operator the message is automatically received and translated into ordinary printed typography ready for delivery, while automatic machinery, without the aid of an operator, takes care of and files away the paper of the transmitted message." So ingenious is this device that a series of messages on a single line may be sent as one message, and each be automatically dropped at its destination, and the capacity of a single wire will exceed the ability of six operators to prepare messages, each of which in its turn may be started by a slight movement of the hand. And this system does not interfere with the use of the wires, on occasion, in the ordinary way. This improved system, so far as it may be adopted, must give us one of the great demands of the age—rapid and cheap telegraphing.

In 1884 Prof. House and his wife removed to Bridgeport, Conn., where two of his nephews reside, who are also known as successful inventors. The fact that he was brought up amid the rugged fields of a mountain farm, while having some disadvantages, enabled him to start in life with strong physical powers, as well as a healthy and vigorous mind. The result is that now, at the age of 74 years, Prof. House enjoys uniform health, and his memory holds tenaciously the diversified facts of his eventful career.

TELEPHONY IN BRAZIL.

WHILE the question as to the proposed amalgamation of the telephone companies in England is to the fore, it may be interesting if we give some particulars which have recently been published in a report regarding the telephone systems in the Empire of Brazil. The report has been prepared by the general management of the Brazilian telegraphs. It appears that telephony in that Empire is in about the same position as in France; that is to say, the management is not well disposed towards private enterprise, and always seeks to concentrate in its own hands a telephone monopoly. Hitherto the erection and working of telephones have been almost entirely in the possession of private individuals, but the advantages and facilities afforded to the public by them are so insignificant, that the management of the telegraphs are desirous that the State should take over the telephone service.

The system established in the town of Maceio has been very successful. The telephone wires are connected with the telegraph office, and subscribers can receive their telegraphic correspondence in their own establishments direct. The rate of payment for the construction of a line is about £22 15s., and the cost per annum for maintenance is £6 15s. Last year the general management of telegraphs obtained authorisation for the putting up of telephonic communication in the towns of Porto-Alegre and Rio-Grande-do-Sul in the same manner as that in Maceio. In an Act of the 24th December, 1881, a clause is found which grants permission for the establishment of electric conductors on private property, without being under the control of the Administration. The result of this has been that many lines have been erected in public streets and in large centres of population, and this has led to much abuse. Private lines can pass from the hands of one person to those of another, and escape State surveillance, and they are in many cases used for the purpose of transmitting clandestine telegraphic messages, to the great detriment of the State, from a financial point of view. Consequently, the management urges that the Government should at once take energetic measures in order to put an end to this state of things, and proposes that the State should construct private lines and connect them with the telegraph offices in groups of fifty subscribers, in the same way as at Maceio; or, on the other hand, the Government should not grant the construction of similar lines without being able to withdraw them whenever it thinks fit to do so. In districts not provided with telegraphic service, it is desired that concessions should only be allowed on condition that private individuals have their lines constructed by the *personnel* furnished by the management, and that they engage themselves by contract to observe all conditions and regulations established by the State; that private lines should be submitted to State control, and that no individual be permitted to put up any lines without authorisation. The propositions which the management of the Brazilian telegraphs make are rather stringent, and, on the whole, we may congratulate ourselves that the telephone service in this country is not now hampered by harassing restrictions. But in France the case is totally different. The use of the telephone there is making but little development, causing no slight dissatisfaction on the part of the commercial community. Only a short time ago a fire broke out in the environs of Paris, but there was no means of communicating, either by telephone or telegraph, with the central fire brigade. The result of this was that before the *pompiers* arrived the building was razed to the ground, notwithstanding the able efforts made by the local fire brigade and volunteers.

BRAZILIAN TELEGRAPH SYSTEM.

THE total length of telegraph lines in the Brazilian Empire amounts to 6,564 miles, having a length of conductors of 11,413 miles. The principal line is that which follows the coast, starting in the North from Sao Luis, in the province of Maranham, and Belem, in the province of Pará, and terminating in the South at Uruguayana and Saquarao, on the frontiers of Uruguay, where connection is made with the telegraph system of the Argentine Republic. The length of this line is 4,284 miles, with 8,241 miles of conductors. There are 170 stations open to public service, with a staff of *employés* numbering 476.

During the last year no important addition was made to the length of lines, but great improvements were effected on the existing system. Wooden posts were replaced by iron ones, and the old insulators removed, those on the Capanema plan being substituted. Storms and floods have been productive of much damage to the lines, but communication has in all cases been speedily re-established. A source of great trouble has been the building of their nests by birds under the insulators, and the lines were frequently destroyed by savage tribes. Two stations were each attacked twice in the past year by hostile Indians, and the Government has under consideration a scheme for settling colonists at intervals along the lines so as to assist military posts in the protection of the telegraph system.

The Administration is about to fit up all those stations which may be favourably situated for the purpose with instruments for making meteorological observations. Considering the immense extent of coast line served by the telegraph lines, these observations are likely to prove of the greatest interest to scientists, in addition to their value in indicating the direction of storms.

Secondary Battery Patents.—Several correspondents who have read our review of Dr. Hoppe's work on accumulators, make anxious enquiries as to where Kirchoff's investigations are to be found. We refer them to Kirchoff's American patent for 1861, which can be seen in the English Patent Office.

ALTERNATING CURRENTS IN ELECTRIC LIGHT WIRES.

THE following, from Mr. George Westinghouse, jun., as president of the Westinghouse Electric Company, appeared recently in the New York *Times*:—

I have been favoured by a correspondent with an article printed in your paper describing an experiment made by one Harold P. Brown, at the Edison laboratory, in Orange, N. J., with the alternating current, and as your journal and others are likely to be misled, the public interests injured and very extensive vested interests also injured, I think it due to those whom I represent to ask the indulgence of your columns for some remarks on that subject.

It is generally understood that Harold P. Brown is conducting these experiments in the interest and pay of the Edison Electric Light Company; that the Edison Company's business can be vitally injured if the alternating current apparatus continues to be as successfully introduced and operated as it has heretofore been; and that the Edison representatives from a business point of view consider themselves justified in resorting to any expedient to prevent the extension of this system.

To show the absurdity of connecting the experiments made at Mr. Edison's laboratory at Orange, N. J., with the commercial use of electric currents, it is only necessary to call attention to the manner in which the current was applied. To use a simple illustration, a piece of lead weighing one ounce may strike the human body with great force in any one of 100 places without producing any permanent injury, and even when fired from a rifle must enter one of the few vital parts to have fatal effect, although when so directed it is perfectly easy to produce instantaneous death. The method of applying the current used in these experiments was carefully selected for the purpose of producing the most startling effects with the smallest expenditure of current, and regardless of any connection between the nature of the current and the special and extraordinary means used to apply the current for these experiments. The parts brought under the action of the current were not only those most easily affected by it, but were so carefully placed in the circuit as to receive a shock such as would be utterly impossible if the current were applied in any ordinary or accidental manner. In order to injuriously affect any organ of the body it is necessary that a certain quantity or volume of current pass through it for a greater or less time dependent upon the amount of the current. To thoroughly appreciate the case it must be understood that the current is increased to a given pressure in exactly the same proportion as the resistance offered to its passage is reduced. It was for this reason that a vital part of the body was selected (in the experiments at Mr. Edison's laboratory) that could be reached by the current without traversing any considerable portion of the body, and in addition to this the resistance of the contacts was made as low as possible by giving them a larger surface and moistening the parts where the electrodes were applied. The result of this carefully arranged plan was that a large quantity of the current was made to pass through sensitive portions of the brain and spinal cord. The same current applied to any other portion of the body would not have been likely to produce any injurious result, and, moreover, in order to produce such a current it would have been necessary to very greatly increase the electromotive force, so that, instead of 700 volts, as claimed in the case of these experiments, several thousand would have been necessary to have the same effect. The usual points of contact in accidental shocks received from electric circuits are through the hands or some other portion of the body protected by tissues of greater or less thickness, and as a matter of experience, it has been found that pressures exceeding 1,000 volts can be withstood by persons of ordinary health without experiencing any permanent inconvenience. Further, the alternating current is less dangerous to life, from the fact that the momentary reversal of direction prevents decomposition of tissues, and injury can only result from the general effects of the shock; whereas in a continuous current there is not only the injury from the latter cause, but a positive organic change from chemical decomposition, much more rapid and injurious in its effects. A large number of persons can be produced who have received a 1,000-volt shock from alternating currents without injury, and among them a wireman became insensible and held his hand in contact with the wires for a period of three minutes without fatal results; in fact, was able to go on with his work after a short period.

We have no hesitation in charging that the object of these experiments is not in the interest of science or safety, but to endeavour to create in the minds of the public a prejudice against the use of the alternating currents. The Edison Company, who are to be benefited by the dissemination of literature of this character, in their annual report, issued this fall, showed that during the past year they sold of their continuous current, 220 volt apparatuses, for central stations, to the extent of 44,000 lights for the current year. The Westinghouse Electric Company, during the month of October, 1888, alone, received orders for 48,000 lights for central station use on the alternating current system, 25,000 of which were for use in London, where the laws with reference to the distribution of electricity are more carefully scrutinised than they ever have been in this country. Since the Westinghouse Electric Company began its business, it has sold more central station plant on the alternating current system than all of the other electric companies in the country put together have of the continuous current system. This large business has been mainly due to the fact that the alternating current system permits the use of an electromotive force which brings the price of incandescent lighting within the reach of the multitude, and enables central station companies to distribute their current over any desired area, such as, for instance, the city of New York and other large places.

One word more with reference to the alternating system: It not only permits the use of a current of 1,000 volts for street mains, but requires its conversion into currents of 50 volts or less for house wiring. The converters are so constructed that the primary or street current can never by any possibility enter the house. With the Edison system the pressure is about 220 volts, and while no person coming in contact with the alternating current as used for domestic lighting would be aware of its presence, with the Edison system the shock would be painful, if not absolutely dangerous, if the person were at all delicate.

We believe there should be reason and right in all things, and that this company is perfectly justified in drawing the attention of the public to the reasons why Harold P. Brown conducts his experiments with alternating currents in the manner stated at the laboratory of Mr. Edison, since, if that company cannot counteract the inroads made into their business by the alternating system, they must necessarily continue to occupy an inferior place, and the protection of their vested interests has led them to use, as correct and proper, any methods that under other circumstances would hardly be resorted to. The Westinghouse Electric Company has introduced its alternating system at the present time into 130 central stations in this country and Canada, all within the brief period of two years. Thirty-six of these stations have increased their plant by ordering additional apparatus from this company after having started with their initial order, and we feel justified in saying that in addition to our own experience with the alternating system the business would not have had this enormous and rapidly increasing growth if there had been connected with it the dangerous features which Mr. Harold P. Brown and his associates of the Edison Company so loudly proclaim.

Finally, we shall be glad to have you send an expert connected with your valuable paper who is disinterested and competent to investigate, free from prejudice, the subject of the alternating and continuous currents. We will afford him every opportunity to satisfy himself of the vast superiority as to safety and economy of the alternating system.

AMERICAN NOTES.

By DAS TELEPHON.

ON Monday, 12th inst., the Supreme Court of the United States announced a decision of great importance to patentees and generally supposed to be of great interest to the American Bell Telephone Company: but, in my opinion, that decision will have no effect on that company other than to call upon its plethoric treasury to pay out its usual exorbitant fees to its astute counsel.

The history of the proceedings which led to this decision is briefly told, and is as follows:—

In 1885, at the instigation and upon the information of a would-be rival telephone company, the attorney-general of the United States applied to the Secretary of the Interior, under whose jurisdiction is the Commissioner of Patents, for information respecting any fraud committed by Prof. Bell or his patent attorney, by means of which the patent of March 7th, 1876, was issued to Prof. Bell. The Secretary of the Interior decided to investigate all the proceedings in the patent relating to the application of Bell for a patent. In this investigation he was assisted by the first and second assistant secretaries and received evidence and heard arguments thereon from the informers and from Bell's attorney. Two questions were submitted for examination. 1st. Was any fraud committed in obtaining the Bell Patent? 2nd. Has the U.S. Government a right to institute a suit to annul a patent for fraud?

After a very long and tedious examination the Secretary of the Interior (who, I should inform you, is a Cabinet minister) decided that there was enough evidence of fraud shown on the hearing before him to require the submission of the matter to the court at the instance of the Government.

Acting on this finding by the secretary the solicitor-general brought a suit to annul the patent, for fraud and other reasons, in the U.S. court in Ohio. The Bell Company demurred to the jurisdiction of the court, on the plea that neither Bell nor the American Bell Company were residents within the jurisdiction of that court.

The presiding judge, after arguments and a long deliberation by him, dismissed the suit.

The solicitor-general then brought suit in Massachusetts, the residence of the American Bell Telephone Company.

The Bell Company demurred to the suit on the ground that in the absence of any statute authorising the Government of the U.S. to bring a suit to annul a patent, the Government has no right to institute such a suit. The court sustained the demurrer and dismissed the suit. The case was then appealed to the Supreme Court of the United States, which was argued on October 9th, and the judgment of the court was delivered on Monday last, 12th inst.

The court very briefly disposed of the first grounds of the dumurrer—that of multifariousness—saying it does not need much consideration, and overruled it.

The court then proceeds to take up the most important feature of the demurrer, the second ground, which alleges that the bill does not show any power or authority, and that no power or authority in law exists, in any person or party or any court, to bring or entertain the suit, and, further, that the complainant has not made or stated a case which calls upon or justifies this court in the exercise of its discretion to permit this bill to be entertained. It will be observed, says the court, that this broad assertion admits that a party may practice an intentional fraud upon the officers of the Government who are authorised and whose duty it is to decide upon his right to a patent, and that he may by means of that fraud perpetrate a grievous wrong upon the general public, upon the United States, and upon its representatives. It admits that by prostituting the forms of law to his service he may obtain an instrument bearing the authority of the Government of the United States entitling him to a monopoly in the use of an invention which he never originated or a discovery which was made by others, and which, however generally useful or even necessary it may become, is under his absolute and exclusive control, either as to the use it may be put to or as to the price he may charge for it during the life of the grant. It assumes that the Government, which has thus been imposed upon and deceived, is utterly helpless, and that it can take no steps to correct the evil or to redress the fraud. If such a fraud were practised upon an individual he would have a remedy in any court having jurisdiction to correct frauds and mistakes and to relieve against accident; but it is said that the Government of the United States—the representative of 60 millions of people, acting for them, on their behalf, and under their authority—can have no remedy against a fraud which affects them all and whose influence may be unlimited.

The United States in the present case is under an obligation to protect the public from the monopoly secured under a patent alleged to have been procured by fraud. The right of the United States to bring this suit is based upon its legal or moral obligation to give a good title. The duty of the Government, it was held, was to protect everybody against the asserted monopoly of a wrongful patent.

The court then takes up the third ground of demurrer, which is that the bill does not set forth any fraud in the procuring of said patents; that it does not specifically set forth what acts, if any, the complainant relies on as constituting fraud in procuring the patents, and that it does not show when, how, from whom, or by what means the complainant first had knowledge or notice of each alleged fact, nor why, with due diligence, it could not have learned them earlier. On this point the court says that the bill alleges that Bell knew at the time of his filing his application for the patent of March 7th, 1876, that he was not the first inventor, as the law required he should be; that the statements made by Bell in his application constituted deception and fraud upon the Government, and did deceive complainant and cause complainant to deliver the patent to Bell, which would not otherwise have been done; that in his application Bell misled the Patent Office by a statement that his invention was for "an improvement in telegraphy," and especially for a patent for a method of "multiple telegraphy," and that he carefully and intentionally refrained from any expression which would lead to the idea that his invention was to be used as a telephone or was capable of such use. The bill also described certain discoveries which anticipated Bell's patent, and which, it is declared, rendered it void, and further states that he practised fraud upon various-named persons. The court is of opinion that if Bell was aware at the time he procured his patents that the same matter had been previously discovered and put into operation by other persons he was guilty of such a fraud upon the public that the monopoly which these patents grant to him ought to be revoked and annulled.

The guilty knowledge is well and fully stated; the prior inventions and their authors are alleged to have been known to Bell and are mentioned with sufficient precision. It is a mistake to suppose that in stating the facts which constitute a fraud where relief is sought in a bill in equity that all the evidence which may be adduced to prove that fraud shall be recited in the bill. It is sufficient if the main facts or incidents which constitute the fraud against which relief is desired shall be fairly stated, so as to put the defendant upon his guard and apprise him of what answer may be required of him. In all these particulars the bill is sufficiently explicit. There can be no question that if the bill be taken as true there is enough in it to establish the fraud in the procurement of the patent and to justify its cancellation.

The United States, by issuing the patents to the Bell Company sought to be annulled, has taken from the public rights of immense value and bestowed them upon the patentee. The Government and its officers, acting as the agents of the people, have taken from them valuable privileges and conferred them upon the patentee. These privileges constitute a property so large that nobody has been able to estimate its value. In argument it has been stated at $25,000,000. This property has been taken from the public and conferred upon the patentees by one of the departments of the Government under the forms of law, but it is charged to have been done because the officers of the Government were deceived and misled by the patentee. That the Government, authorised both by the Constitution and the statutes, to bring suits at law and in equity, should find it its duty to correct this evil, to recall these patents, and to give a remedy for this fraud is so clear as to need no argument, and the proper remedy, it seems to the court, is the one adopted by the Government in this case. We think that the doctrine that the United States is not entitled to obtain the cancellation of an instrument obtained from it by fraud—an instrument which affects the whole public whose protection from such a fraud is eminently the duty of the United States—is not sound. The decree of the Circuit Court of Massachusetts dismissing the Government's bill is, therefore, reversed, and the cause remanded to that court with directions to overrule the demurrer, with leave to the defendants to plead or answer, or both, within a reasonable time to be fixed by that court. Opinion by Justice Miller. Justice Gray was not present at the argument, and took no part in the decision of this case.

"I told you so." In the "American Notes," published in the REVIEW of April 27th, 1888, will be found the following sentence in page 442:—"I am well convinced that the court will decide that the United States Government has a right to institute such a suit, although there is no express statute conferring such a right, and I am equally confident that should the case be tried to annul the patent, the Government will not be able to establish any fraud, and this opinion I have formed after careful examination of all the fraudulent charges made. There was no fraud, and Bell's patent will be sustained."

"I told you so." In the REVIEW of January 6th, 1888, page 14, will be found in "American Notes" the following sentences:—"The United States Supreme Court has not yet given its decision in the Bell Telephone Case. . . . I believe the Bell Patent will be sustained by the court."

In the REVIEW of April 6th, 1888, will be found in "American Notes" the decisions of the United States Supreme Court, rendered on 19th March, 1888, in the case argued before that court in January, 1887—a decision sustaining the validity of all the claims in both of Bell's patents; and in the REVIEW, page 403, of the 14th October, 1887, will be found the following sentence:—

"I attended daily the trial of the Bell case before the United States Supreme Court in January, 1887, and from the arguments on both sides, and from the evidence filed in the lower courts, I do not hesitate to express my strong belief that the fifth claim will be sustained."

All my "say-sos" anent the Bell patent and the Supreme Court have been verified, and, I am sure, firmly fixed in my opinion; my "say-so" that the Government will not be able to prove any fraud in obtaining the Bell patent, in case the suit should ever be tried, which I doubt, for two reasons: 1st, I am strongly inclined to believe that the Solicitor General will be so doubtful of the success of a suit that he will let it be dismissed; and 2nd, I think the court in Massachusetts will not take up the case until after the 4th March next, even if urged to do so by the present Solicitor-General and the new Attorney-General, under the new Republican President, will not prosecute the case. As a matter of course I went to Washington and was in court to hear the opinion delivered in this important case. I took advantage, while in Washington, to pay a visit to the laboratory of M. Emile Berliner—when I witnessed the whole operation of his beautiful invention, the "gramophone,"* of which I will write in my next; and I shall also speak of his invention of the "microphone," and the use of carbon in a microphone in April, 1877.

Baltimore, *November 16th*, 1888.

It is universally acknowledged that to the inventor of the microphone the world is indebted for the practical use of the electric telephone, and it is just and proper that due credit should be awarded to him, whose brain worked out logically and scientifically that beautiful and simple contrivance, by means of which our expressed thoughts are transmitted to listening ears in far distant places on the wings of lightning.

The names of several persons have been mentioned as the inventor or discoverer of the microphone.

The records of the United States patents contain the following claim, forming part of a caveat filed in that office on 14th April, 1877, and sworn to on 13th April, 1877, by the inventor, as is required to be by the Patent Laws.

Claim.—"In an instrument situated within an electric circuit having two or more ends of the circuit brought in contact with each other, which points of contact can be loosened or tightened by vibrating one or both sides of each contact, thus diminishing or increasing the current of electricity passing through the contacts as many times as vibrations occur."

Sworn to April 13th, 1877, by Emile Berliner.

It is unnecessary here to recall the names of others, who themselves have claimed to be the inventor, or for whom their friends have claimed it.

The recorded evidence cited above establishes beyond any doubt that on April 13th, 1877, Emile Berliner *invented* the microphone, and unless evidence equally reliable can be produced that some other person had invented it prior to that date, it is just and proper to write

"Palmam Berliner, qui meruit, ferat."

It is incumbent upon the editors of the REVIEW, as well as upon all persons who may have reliable evidence of a prior invention of the microphone to produce it now.

On January 1st, 1889, the law requiring electrical executions in New York State goes into effect, but the amount and character of current required to make death certain and instantaneous has not been determined. The experiments upon dogs made last summer by Harold P. Brown, the electrical engineer, were criticised because the weight of the animals killed was less than that of a man, and it was supposed that more current would be required to kill a human being on that account.

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* This was described in the REVIEW for December 7th, 1888.

Mr. Brown was given an opportunity to make a demonstration before Mr. Elbridge T. Gerry, author of the electrical execution law, and the committee appointed by the Medico-Legal Society to report on the best means of putting the law into effect.*

The experiments proved the alternating current to be the most deadly force known to science, and that less than half the pressure used in this city for electric lighting by this system is sufficient to cause instant death.

It is understood that R. R. Dobell, a leading Quebec lumber merchant, is organising a company with a capital of about $2,000,000 to undertake the laying of a telegraph cable from Blanc Sablon, at the Straits of Belle Isle, to a point on the coast of Scotland or Ireland. The Dominion Government will probably agree to extend the present telegraph line on the north shore of the gulf from Mingon to Blanc Sablon, and hand the entire gulf and coast telegraph system over to the new company, as a subsidy in aid of their enterprise. The Dominion Government, it is said, have received from a London company an offer to lay a cable from Halifax to Sable Island for $100,000, and it is probable that the necessary grant of money to enable them to accept the offer will be asked for at the coming session of Parliament.

The Commercial Cable Company has issued a circular announcing its purpose to continue legitimate competition for business. It claims to be misrepresented with respect to its relations to the cable pool. Manager Ward says that cutting of rates is not intended, and the best of feeling exists between all the companies.

The Postal Telegraph Company proposes to construct a line from Washington City to New Orleans, with offices at all intermediate cities. Mr. Joseph W. Kates, late general manager of the Southern Telegraph Company, is now in the South making arrangements for the opening of the new line. Albert B. Chandler is to be the president of the new company. It is claimed that there is plenty of money behind this new enterprise, and that when the line is constructed it will prove a formidable competitor of the Western Union in the South.

A syndicate, consisting of the Edison Electric Light Company, Messrs. McLennan and Conway, engineers, and several Montreal capitalists, have purchased from the Mathews estate, for $20,000, the Isle au Heron, which is situated right in the middle of the Lachine Rapids. It is stated that the syndicate purposes utilising the magnificent water power, which can be obtained by deepening the natural channel by which the island is intersected, and by directing a large body of water through it by means of breakwaters and dams. The company proposes tendering for the lighting of the city of Montreal by electricity, as well as furnishing private houses, manufactories, and other establishments with the light.

The Committee appointed by Congress to investigate the workings of the "Copper Syndicate" has elicited the following statement under oath from Mr. John Stanton, counsellor and treasurer of the Lake Superior, Allouez, and other mining companies. He said that the company he represented made an agreement with the French syndicate in April last to furnish them with all the copper produced for the term of two years and eight months. The product of the Lake Superior copper mines was about 72,000,000 lbs. The mines he represented produced the bulk of this amount. The Montana mines produced last year about 79,000,000 lbs., about three-fifths of which was produced by the Anaconda mine. The Arizona mines produced about 18,000,000 lbs. Since this agreement was formed the price of copper in this country has advanced to about 17 cents per lb. Last year it was 16 cents, and before that had ranged as low as 11 cents for a number of years. He understood that the French syndicate was endeavouring to secure control of the copper market, not only in this country, but in Spain and in other European countries.

New York, *December 15th*, 1888.

THE CITY LIGHTING.

THE following is the report of Mr. W. H. Preece, F.R.S., given to the Commission of Sewers through the medium of Lieut.-Colonel Haywood, the City Engineer :—

November 7th, 1888.

Lieut.-Colonel Haywood.

Dear Sir,—I assume that it has been decided to light the City by electricity, and that the questions for me to report upon are the best method of doing it, and the best means of applying that method. My views with regard to electric lighting and its application to the City were so fully detailed in my report of July 26th, 1883, that there remains very little for me to add. Notwithstanding the five years' subsequent experience that we have had of electric lighting, and the careful inspection that I have been able to make in America and on the Continent, I find no reason whatever to depart from the general conclusions contained in my previous reports.

It has been asserted that I condemned the arc lamp. I never did actually disapprove of the arc system. I simply showed by experiments that there were conditions where glow lamps were more economical, and in certain circumstances, preferable for street lighting than arc lamps. Many of the objections, however, which I then adduced against arc lighting have now been removed. Arc lamps have become very much steadier, the flickering has almost entirely disappeared, and there are some lamps in use which are absolutely steady. They involve less personal attention, and there are fewer failures from defective and broken carbons, and from other causes, which militated so much against them six or seven years ago.

The improvements in arc lamps have been so marked that there are even conditions where they might be advantageously applicable to indoor lighting. The reading room at the British Museum, which has been under my responsibility, has been most efficiently lighted by arc lamps for the past four years or more. I am now conducting some careful experiments in the Post Office to determine whether arc lamps will not be more efficient and more economical in telegraph galleries and our sorting rooms; in fact our Glasgow Post Office is so lighted.

On the other hand there are many practical difficulties in properly applying glow lamps to illuminate main thoroughfares under the best circumstances. I had pointed out in my report of July 26th, 1883, that the most effective way to light a street is to suspend 50-candle glow lamps down the centre of the street, and 25 feet above the road-way, but the difficulty of doing this while fire escapes are allowed to pass through our thoroughfares militates very much against this plan. The arrangements which were thoroughly discussed between you and me, and which were embodied in the draft agreement, negotiated, but not confirmed, with the Anglo-American Brush Company, were a compromise between the two systems. I am quite clear that the lighting of the City must be by a proper distribution of arc lamps and glow lamps, arc lamps in the main streets and open spaces, and glow lamps in the narrow bye-streets and courts.

The present competition amongst electric lighting companies is very keen. Not only are the Anglo-American Brush Company desirous to complete the arrangement provisionally agreed upon, but we also have the London Electric Supply Corporation, which is establishing a large central station at Deptford, and proposes to bring up by means of the railways to the Monument and Cannon Street powerful currents which can be distributed over the whole City. The Metropolitan Electric Supply Company also contemplates establishing central stations on the borders of the City, they are constructing a station for 60,000 lamps in Sardinia Street, Lincoln's Inn Fields, and have taken premises near Southwark Bridge, on the Surrey side, with the view of supplying electricity to the City. I have also heard of other schemes which are hatching for the same purpose in other parts of the metropolis, so that altogether we shall have a series of associations desirous of entering into relations with the Commissioners of Sewers for the public and private lighting of the City. To give all a chance to compete, I suggest that the City be divided into three distinct districts, as is indicated on the enclosed map, and that tenders be invited from those who are able and who are desirous of supplying light for public purposes, as well as for the supply of electricity for private and domestic lighting.

I have sketched the heads of a broad specification which might be used for this purpose (Appendix A). It is sufficiently wide to enable each firm tendering to specify the mode in which it is proposed by them to distribute the current and to light the street.

I beg to suggest for the careful consideration of the Streets Committee the undesirability of throwing this work open to public tender. To do so is to court wild and impracticable proposals from schemers and speculators. There are at the present moment only three companies, as far as I know, in a position to supply the current to the City :—The Anglo-American Brush Company, the London Electric Supply Corporation, and the Metropolitan Electric Supply Company. Your committee would scarcely think of inviting tenders for supplying gas or water from anyone but the existing companies. Why should they act differently with electricity? Each of these companies is, as far as I am aware, a sound concern. They are all quite competent to carry out any agreement they may enter into. The previous experience of your committee in inviting public tenders has been very discouraging, and it appears to me that the chief delay that has arisen lately has been due to the consideration that has been given to embryo and undeveloped schemes. The establishment of electric lighting in the City means the expenditure of a large capital—certainly over one million—and I submit that your committee should enter into negotiation with none but financially and commercially solid concerns, unless they are prepared to find the capital themselves —a contingency that is not under discussion.

I am, yours faithfully,
W. H. PREECE.

APPENDIX A.

SUGGESTED OUTLINE OF SPECIFICATION.

1. The City will be divided into three districts, marked west, central, and east, and coloured in different colours on the annexed map.

2. Tenders will be required to light the main streets, bye-streets, courts and thoroughfares in each district, by means of the electric current.

3. The tender must specify the way in which it is proposed to

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* Mr. Brown's results were published in brief in our last issue, but a more detailed account will be found in our other pages.—EDS. ELEC. REV.

illuminate the thoroughfares, whether it be by arc, or by glow lamp, the number and position of each kind of lamp, their capacity and efficiency, where the currents will be generated, and how they will be distributed.

4. The party tendering may have the right to provide domestic and private lighting in the district or districts, and it will be necessary to specify how it is proposed that this shall be done.

5. The service for public lighting must be from sunset to sunrise, but it will be necessary to specify how it is proposed to provide against sudden accident or the pressure of fogs, and how reliable and effective maintenance of the system is to be secured.

6. The mains, service leads, and conductors must be placed underground, they must be subject to inspection and test, and they must comply strictly with the rules of the fire offices and the official regulations that are based on the Acts of Parliament of 1882 and 1888.

7. All the lamps must be guarded to prevent falling carbon or ascending sparks, globes must be protected with wire netting, the light must be steady, there must be no flickering, and the lamps must be well and properly distributed.

8. The service for private lighting must be continuous, constant, and uniform throughout all hours of the day.

8. The mode and rate of charging, and the terms on which additions and alterations are to be carried out, will be specified and scheduled.

10. The contract is to be determinable at periods not exceeding seven years, and it is to have the usual fine and penalty clauses, protecting the Corporation from insufficient and improper service.

11. The existing gas service is not to be interfered with or prejudiced in any way.

NEW PATENTS—1888.

17881. "Improvements in metal arms or brackets for telegraph or telephone posts." J. S. Crowley. Dated December 7.

17893. "Improvements in *fac-simile* telegraphic apparatus." A. McKeand Cochrane. Dated December 7.

17905. "An improved rotary dynamometer." J. Kasalovsky. Dated December 7. (*Complete.*)

17911. "Improvements in apparatus for indicating the period electric lamps are caused to burn." A. H. Fletcher and S. W. Cuttriss. Dated December 7.

17915. "Improvements in the insulating of electrical machines and conductors." G. R. Gibson and A. F. Macfarlan. Dated December 7.

17918. "Improvements in electrical counting mechanisms." F. E. MacMahon. Dated December 7:

17927. "An electric steering indicator." A. C. Boursot. Dated December 7.

17929. "Improvements relating to the application of electricity to Turkish, hot air, vapour baths, and the like." J. J. Wilkinson. Dated December 7.

17964. "Improvements in electric generators and motors." Siemens Bros. & Co. (Communicated by A. M. Taylor, India.) Dated December 8.

17983. "Improvements in shade carriers for electric incandescent lamp holders affording more rapid means of fixing and unfixing the shades." H. W. Bishop and F. Brown. Dated December 10.

18018. "Improved electric automatic fire-alarm." H. B. Phillips and W. Mitchell. Dated December 10.

18022. "Improvements in dynamo-electric machines." C. E. L. Brown. Dated December 10.

18035. "Improved apparatus for regulating and measuring electric potentials and currents." Sir W. Thomson. Dated December 11.

18057. "Improvements in cut-out apparatus for electric lamps." P. M. Justice. (Communicated by C. Heisler, United States.) Dated December 11. (*Complete.*)

18091. "Improvements in electro-motors." W. Aldred. Dated December 11.

18108. "Improvements in casings for electric cut-outs." H. H. Lake. (Communicated by S. Bergmann, United States.) Dated December 11.

18116. "Improvements in electrical primary batteries." A. B. Atkinson and H. Metcalf. Dated December 12.

18137. "Improvements in simple and compound switches for electrical currents." W. Hartnell. Dated December 12.

18154. "Improvements in and relating to door locks and fastenings, consisting of an electro-magnetic lock connected with an alarum." P. C. Wood. Dated December 12.

18187. "Improvements in electric generators and in electro-motors." M. Immisch. Dated December 13.

18220. "Improvements in electricity meters or coulomb meters." E. Batault. Dated December 13. [Dated applied for under Section 103 of the Patents, &c., Act, 1883, July 28, 1888, being date of application in Belgium.]

18233. "Improvements relating to duplex electric telegraphs." H. A. Taylor. Dated December 13.

18245. "Improvements in electric lamps or lighting apparatus." C. Coerper. Dated December 14. (*Complete.*)

18255. "Improvements in electric alarms." N. G. Thompson. Dated December 14.

18262. "An electric speed regulator for marine engines." P. W. Sothmann and C. O. H. Kroll. Dated December 14.

18278. "Improvements in laying electrical conductors under ground." G. Wilkinson and L. W. Holmes. Dated December 14.

18306. "Improvements in the construction of apparatus for communicating currents of electricity to persons on the introduction of specified coins or checks." A. Serraillier, J. T. Armstrong, and The Automatic Electric Supply Company, Limited. Dated December 14.

18319. "Improvements in or relating to suspenders for shades or lamps, especially applicable to electric lamps." W. S. Boult. Dated December 15.

18331. "Improvements in electro-dynamic engines for hauling or propelling vehicles on railways and tramways." H. P. Holt. Dated December 15.

18380. "An improved instrument for regulating electromotive force." W. H. Douglas and T. H. Parker. Dated December 17.

18416. "Improvements in apparatus for measuring currents of electricity." M. J. R. Jacquemier. Dated December 17. (*Complete.*)

18450. "Improvements in dynamo-electric machines and electric motors." J. Y. Johnson. (Communicated by C. S. Bradley, United States.) Dated December 18.

18494. "Improvements in galvanic batteries and in the arts." I. L. Roberts and H. L. Brevoort. Dated December 18. (*Complete.*)

18500. "Improvements in means or apparatus for use in laying or conveying underground electrical conductors." B. Verity and J. B. Verity. Dated December 18.

18505. "Improvements in electrical torches for lighting gas." H. B. Sheridan. (Communicated by J. D. Culp, United States.) Dated December 18.

18526. "Improvements in submarine telegraphic cables." J. C. L. Loeffler. Dated December 18.

18589. "Improvements relating to secondary batteries." J. L. Huber. Dated December 19.

18608. "Electric bells." R. W. Paul. Dated December 20.

18636. "Improvements in electrical accumulators." J. C. Fuller and G. Fuller. Dated December 20.

18659. "An improvement in electric motors worked by alternating currents." Siemens Brothers & Co., Limited. (Communicated by Alfred Miles Taylor, India.) Dated December 20.

18660. "An improved manufacture of wire coated with copper or other metal for electrical conductors and other purposes." E. Martin. Dated December 20.

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1887.

14494. "Improvements in electrolysing chlorides, bromides and iodides, and in the utilisation of the products thereof." W. Spilker. Dated October 25. 8d. Consists essentially in the following :—The inventor obtains the suppression of the polarisation of the chlorine by the introduction of slaked lime (or quick lime dissolved in chloride of calcium, and consequently changed into basic chloride of calcium) into the anode compartment, which is separated from the cathode compartment by a diaphragm of porous clay or similar material. He obtains by this way, by one fabrication, firstly in the cathode compartment the alkali perfectly or nearly free from chlorine, secondly, in the anode compartment the chlorates respectively by a low temperature the hypochlorites of potash or soda or calcium mixed with clorides of calcium. By an analagous method he obtains the bromates and iodates. The polarisation of the hydrogene, which is produced by the decomposition of the haloid salts of the alkali or similar metals, will be suppressed by means of a continuous current of air or steam, or a mixture of both, blown over the surface of the cathode, so that the solutions shall completely come in contact with the anodes and cathodes and be decomposed. The claims are 11 in number.

16296. "Improvements in primary and secondary galvanic batteries." A. F. St. George and C. R. Bonne. Dated November 26. 8d. Claims :—1. In the construction and use of a galvanic primary or secondary cell the combination with one or more tin elements of metastannic hydrate solid, powder, paste or material or solution, substantially as and for the purposes described. 2. In the construction and use of a galvanic primary or secondary cell, the combination of metastannic hydrate material and nitric acid pure or diluted, arranged and actuated substantially as and for the purposes described. 3. The combination of the negative element of the metastannic cell with the nitric acid pure or diluted, and the metastannic hydrate material, arranged and actuated substantially as and for the purposes described. 4. The combination of a perforated or porous negative element with the metastannic hydrate material, arranged and actuated substantially as and for the purposes described. 5. In the construction and use of the metastannic hydrate cell, the combination with the elements of the cell, and the metastannic hydrate material of capillary, syphon, dipping, soaking and charging devices, substantially as and for the purposes described. 6. In a primary or secondary galvanic cell the combination with the metastannic hydrate material of a hollow element for containing acid, substantially as and for the purposes described. 7. Combining sand or absorbent earth or other suitable material with the metastannic hydrate material, wet or dry, substantially as and for the purposes described. 8. Absorbing the fumes of a metastannic hydrate cell and utilising them to manufacture metastannic hydrate material, substantially as and for the purposes described.

16455. "Improvements in secondary or storage batteries." H. THAME. Dated November 30. 6d. Claim:—In the manufacture and use of secondary or storage batteries for electricity the employment of uncured or unvulcanised India-rubber or ordinary gutta-percha or other suitable material or compound capable of being vulcanised, with which is incorporated lead in a finely divided or separated condition, in manner and for the purposes substantially as set forth.

16603. "Improvements in electric lamps and in dynamos for the same for velocipedes or the like." A. J. BOULT. (A communication from R. Weber, of Leipsic.) Dated December 2. 8d. Consists in an incandescent lamp in connection with a very small but very powerful dynamo-electric machine worked by the revolving wheel of the velocipede. The claims are 3 in number.

16962. "Improvements in stays for telegraph poles, masts and the like." F. RUDALL. Dated December 9. 8d. Claim:—The insertion of a spring or other electric medium in otherwise rigid stays for supporting poles, posts, staffs, masts and similar erected objects, arranged and working substantially as described and in part illustrated in the drawings.

17155. "Improvements in incandescent electric lamps and cut-out devices therefor." T. A. EDISON. Dated December 13. 8d. Claim:—The incandescent electric lamp provided with a spring cut-out held out of action by a fine wire situated between the leading-in wires, whereby, when said wire is fused the cut-out is released and the lamp is cut out of circuit, substantially as described.

17508. "Improvements in electrical switches." F. L. RAWSON and W. WHITE. Dated December 20. 8d. Claims:—1. In an electric switch the combination on a single axis of two or more elastic switch arms reacting against one another so as to produce mutual contact pressure upon their respective contact pieces, substantially as described. 2. In an electric switch the combination of such duplicate or multiple elastic switch arms with a spring or springs producing a quick automatic break from the contact pieces in conjunction with an operating thumb piece or hand lever permitting independent movement of the switch arms to break, substantially as described. 3. In an electric switch the construction of the thumb piece or hand lever, consisting of a pair of projecting pins outside a central hole, fitting loosely over the switch axis, the pins engaging in arc slots in the head of the said axis, substantially as and for the purposes described. 4. In an electric switch the combination of two reacting switch arms, both being in multiple arc, the second arm being made to break contact after the first arm has ceased to make contact, substantially as described.

17528. "A method and apparatus for phonic reception of telegraphed communications." C. ADER. Dated December 20. 8d. Claims:—1. Effecting phonic reception of alternating line currents by dividing them into fractions, half of which are made to pass by one route and half by another route to a receiver or receivers, both routes being affected by local currents in such a manner that a fractional positive impulse is reinforced on the one route and neutralised on the other, and a fractional negative impulse is neutralised on the former route and reinforced on the latter, substantially as described. 2. The application of phonic receivers actuated as above described by alternating currents, distinguishing by the ear the positive and negative currents as representing Morse dots and dashes. 3. For fractionally dividing the line currents, the use of two vibrators of different pitch, substantially as and for the purpose set forth. 4. As apparatus for phonic reception of alternating line currents, the combination of one or more vibrators, one or more local batteries, and a pair of telephonic receivers or one receiver double coiled, connected and arranged substantially as described.

17585. "Improvements in electric regulators." N. BENARDOS. Dated December 21. 6d. Claims:—1. An electric resistance regulator wherein a mass of carbonaceous material is more or less compressed between conducting plates within an insulating casing, substantially as described. 2. The combination of a number of regulators of the kind referred to above with connections for grouping them in tension or in quantity, substantially as described.

17699. "Improvements in telephonic apparatus." D. J. SMITH and D. SINCLAIR. Dated December 23. 8d. Claims:—1. The arrangements of telephonic switchboard apparatus described with reference to the drawings whereby connection between two subscribers may be made at the exchange by the use of a single cord and subscribers may be called by the exchange operator in the act of making connection. 2. In telephonic switchboard apparatus a plug provided with a switch and connections to a magneto or battery whereby a subscriber may be rung up in the act of inserting the plug into the jack constituting the switchboard terminal of that subscriber's line, substantially as described.

17762. "Improvements in electric signalling apparatus." L. SELLNER. Dated December 24. 11d. The invention has for its object to avoid the diminutions of intensity of the light, as occurring with coloured lamps and thereby to render the apparatus serviceable for greater distances. The claims are 8 in number.

17768. "Improvements in apparatus for covering or insulating wire." WILLOUGHBY S. SMITH the Younger. Dated December 24. 8d. Claims:—1. Forcing apparatus for covering or insulating wire consisting of a casing in which there are two revolving toothed surfaces, the covering material being conveyed in one direction in their teeth and prevented from returning by reason of the teeth gearing together at one point. 2. Apparatus for covering or insulating wire consisting of a drum into which the material is fed by rollers or other feeding mechanism and within which are a toothed ring and a pinion gearing together one of them being driven from without and also a partition, past which the material is carried by the teeth of the ring and pinion and is forced out towards a die through which the wire is led, substantially as described. 3. The apparatus substantially as described and shown in the drawings.

17812. "Improvements in machines for the production of alternating electrical currents." C. ZIPERNOWSKI. Dated December 27. 8d. The improvements are as follows: The cores of the electro-magnets, which induce currents in the armature, and round which the direct or continuous current flows, are divided many times in a direction parallel with the lines of force; they may for this purpose be composed of iron wire or of thin iron plates, which, as far as possible, are continuous in the direction of the lines of force, and are insulated from one another by layers between each plate or wire of shellac, paper leaves, natural or artificial layers of iron oxide, or the like. There is 1 claim.

17926. "Safety fuses for electrical circuits." W. E. HAYNE. Dated December 30. 8d. The inventor places in the circuit to be protected from an excess of current a short piece of lead, tin, or other suitable fusible material, fixed at its extremities by any convenient means, the said fuse piece being acted upon by a spring or springs, which exert either a pulling or pushing force upon it; the spring (or springs) itself, however, forming no part of the electrical circuit. When the strength of the current is in excess of that normally required, the lead or other fusible material becomes more or less plastic, and being acted upon by the spring force is pulled or pushed apart, the circuit being consequently broken. The claims are 4 in number.

1888.

7853. "Improvements in or relating to storage batteries." W. P. THOMPSON. (A communication from abroad by C. D. P. Gibson, of America.) Dated May 29. 8d. Consists, in general terms, in uniting two separate plates or sheets of lead, each of which has inclined openings or perforations formed within it, and in making these, the metal of the plate is pressed inward immediately above each opening and outward below the opening. The two plates thus formed are then placed against each other with the inward projections in contact with each other, either touching each other at the extremities or locking into each other. The claims are 5 in number.

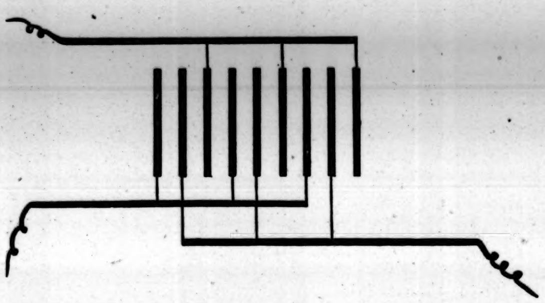
7977. "Improvements in the mode of filling secondary battery plates." H. G. MORRIS and P. G. SALOM. Dated May 31. 6d. Claims:—1. The mode described of forming secondary battery plates, said mode consisting in filling the cells or interstices of the grid with powdered active material, placing a uniform layer of said active material on one or both sides of the grid, and then compressing the surplus material into the cells of the grid. 2. The mode described of filling a secondary battery plate, said mode consisting in mounting the grid on a supporting plate, applying a retaining frame to the top of the grid, placing the active material in the cells of the grid and piling it above the same, removing the surplus material until it is level with the top of the retaining frame, and then removing the latter and compressing the surplus material into the cells of the grid. 3. The mode described of filling a secondary battery plate, said mode consisting in mounting the grid on a supporting plate, applying a retaining frame to the top of the grid, filling the cells of the latter with active material, and piling the latter above the same, removing the surplus material until it is level with the top of the retaining frame, then reversing the grid and repeating such operations on the other side of the same, and finally compressing the two layers of surplus material into the cells of the grid.

8171. "Improvements in magneto-electric liquid level indicators." J. J. GHEGAN. Dated June 5. 8d. Is for the purpose of dispensing with the float and to simplify the magnetic circuit controller. A balance that is moved by the alternate rise and fall of the liquid accomplishes the former, and a movable permanent magnet effects the latter. The claims are 6 in number.

CORRESPONDENCE.

A New Form of Condenser.

In cases where two condensers have one pole or armature of each joined to a common terminal (*e.g.*, cable duplexing with condensers in arms of the bridge) it might be advantageous to combine the two in one instrument. I beg to suggest the following :—The diagram is self-explanatory, foils 1·4·7·10·13, &c., joined; foils 2·5·8·11·14, &c. ; and foils 3·6·9·12·15, &c. Such a combination I should term "trefoil" or "tripolar," as distinct from the ordinary condensers. Obviously such could be used on occasion as a "bipolar" condenser by joining any two of the three sets of foils to form one pole. Objection will be made that the capacity would not compare favourably with the surface dimensions due to the fact that only one side of a foil is under *direct* influence (nota bene—*not* induction). This disadvantage may or may not be counterbalanced by the other considerations ; as to which I should feel honoured by your able criticism.



W. Perren-Maycock, *A.S.T.E.*

January 1st 1889.

Chemical Affinity as Related to Thermo-Electricity.

It is very probable that before many years are past, and by the study of the closely connected sciences of electricity and chemistry, we shall be able to establish a law by which any combinations of matter may be as accurately foretold, provided the temperature be given, as that all forces dissipate themselves by the easiest roads.

For instance, is it not truth to say that when the junction of two metals is heated so as to set up an electric current in a closed conductor, and at a temperature such that the metal, A, acts positively at the junction, and the temperature be increased so that its positiveness is diminished and a point zero is reached, that that zero electric point of temperature is the zero point of what is termed chemical affinity between the two elements under operation ? If after reaching the zero point the temperature be increased so that the other metal, B, becomes positive, as indicated by the current being reversed, is there not every chance that by ascertaining the ratio of temperature to effect, above and below zero, of all the elements, that we shall have the key to chemical affinity ? I am aware of many difficulties to be confronted in ascertaining the electrical data, with all the solids, liquids, and gases.

We can hardly have a better illustration, in a practical way, of the difference temperature makes than that of potassium or sodium. Normally, they stand at the positive end of the series, but increase the temperature, and they can be isolated by other elements whose combinations would explode with them at a lower point. Fine aluminium, when heated with peroxide of iron, is said to explode ; but, from other evidences of the properties of iron, there are good reasons for believing that a temperature can be reached at which iron would reduce aluminium ; if not the oxide, at least the chloride, as by volatilising chloride of aluminium over incandescent iron. Or, take another example, that of an electrolysed solution of the mixed chlorides of sodium and calcium ; at normal temperatures the calcium gives way ; when fused together and electrolysed the calcium frees the sodium.

A diagram of the thermo-electric power of metals has already been made, and Prof. Tait, I believe, has given a formula for calculations based upon it ; but I am not aware of the principle ever having been applied to the investigation of chemical affinities.

If the electric phenomena can be proved to be true chemically, as it should be, not merely day-to-day operations would be assisted, but a great light might be thrown upon the natural changes of matter, and might satisfactorily explain the necessity for time, in the absence of higher temperatures, to effect some of the changes treated of in geology, and the increase and decrease of affinity, &c., may possibly require some different algebraical power for each element as the square, cube, or xth power of temperature—positive and negative.

One point, however, I think, may be accepted, and that is that so far as metallurgy is concerned, the thermo-electric lines are reliable, and only lack one thing, the carbon line. Perhaps someone having the convenience will do it, as well as a few of the other metals, which appears not to have been studied because impracticable for electric generation ; but for chemistry they will be very valuable.

Samuel Richardson.

January 1st, 1889.

Protection of Telephones.

The fusible wire mentioned by Mr. Campbell Swinton has been discarded in the United States for a more sensitive magnetic device which opens circuit when the current exceeds one ampère. When last in New York, I made some very satisfactory experiments with one of my cut-outs fitted with a special mica foil, which invariably fused with one ampère ; and some of these sensitive cut-outs are, I believe, still at work. I cannot agree with you when you say that electric light companies "should steer clear of the telephone network ;" as a short circuit or an earth is much more likely to occur through a telephone wire falling on to an electric light wire and cutting through the insulation than from the opposite cause. I think the telephone companies should be compelled to adopt rules for the protection of their subscribers similar to those which have been imposed on the users of electric light by some of the insurance companies—but would they bow their heads to Baal ?

Killingworth Hedges.

January 1st, 1889.

A Protest.

I shall esteem it a favour if you will allow me through your columns to enter my protest against the increasing practice of some electrical supply firms of appropriating other people's designs and ideas.

The case I wish more particularly to notice is that of a German firm in London, which has just issued a new catalogue and price list, and have included therein, among many other designs, a system of theatre lighting and controlling, patented by Mr. E. L. Berry and myself, without even the courtesy of requesting permission to do so, or mentioning whose arrangement it is. I may mention that we have the sole right to determine who shall manufacture and supply the goods. I feel sure the majority of your readers will agree with me that this is not a legitimate way of soliciting business.

S. Sudworth.

January 2nd, 1889.